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THE AMERICAN GEOGRAPHICAL SOCIETY

THE American Geographical Society is the oldest geographical society in the United States. Its objectives since the foundation in 1852 are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The Society publishes the *Geographical Review*, a quarterly magazine issued in January, April, July, and October, and a series of *Special and Research Publications* of comprehensive scope. The library is one of the largest geographical libraries of the world; in addition to the usual functions it maintains a Research Catalogue and issues the periodical *Current Geographical Publications*. Besides its modern cartographical material the Society possesses a valuable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries. Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the collections.

Four gold medals are awarded by the Society: the *Cullum Geographical Medal*, the *Charles P. Daly Medal*, the *Samuel Finley Breese Morse Medal*, and the *David Livingstone Centenary Medal* (founded by the Hispanic Society of America).

The Society has also for many years promoted studies relating to questions of wide public interest; for example, settlement in the pioneer belts of the world, the problem of the white man in the tropics, the bearing of geography on international relations, the historical geography of the United States, polar exploration and geography. The Society is also engaged in the development of new techniques and instruments designed to increase the efficiency and reduce the costs of surveying and mapping; and it has long been at work on a great standard map of the Americas from the Mexico-United States border to Cape Horn. This map, in 107 sheets, which is now completed and under revision, is a project of direct utility to scientists, businessmen, and government officials concerned with Latin America.

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Annual Fellowship dues, \$10.00; Sustaining Fellowship dues, \$25.00 per year; Life Fellowship, \$200.00; Patron, \$1,000.00; Benefactor, \$5,000.00.

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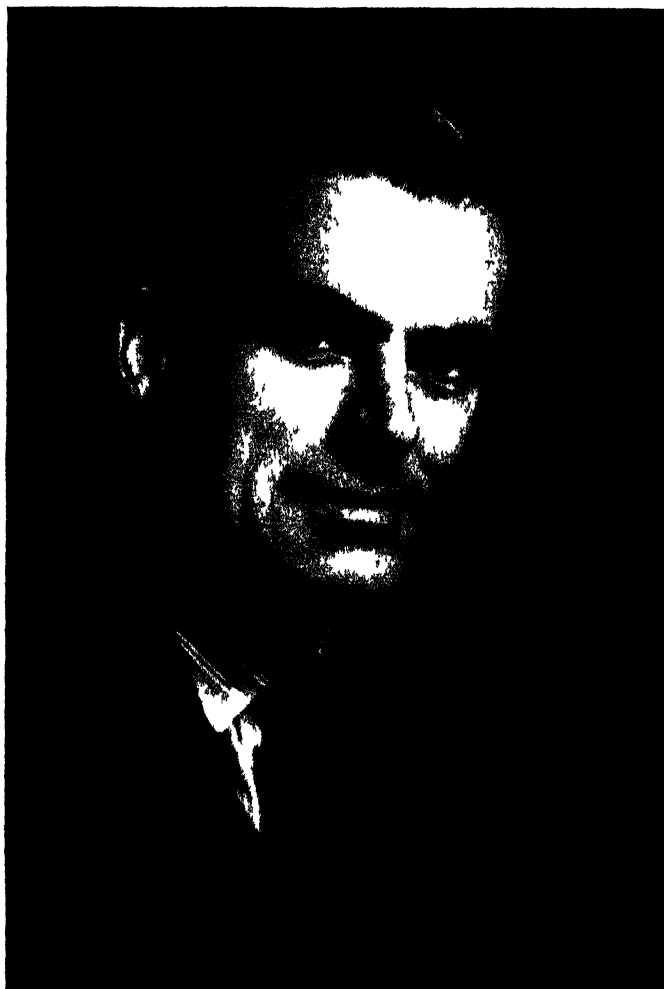
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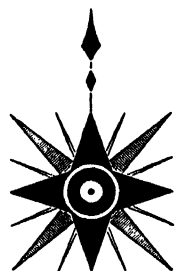
GEORGE H. T. KIMBLE

The Geographical Review

VOLUME XL

January, 1950

NUMBER 1



GEORGE HERBERT TINLEY KIMBLE

THE Council of the American Geographical Society announces with pleasure the appointment of a new Director. George H. T. Kimble, Professor of Geography and Chairman of the Department at McGill University, Director of that University's Meteorological Observatory and of its Geography Summer School, and Secretary of the International Geographical Union, has received and accepted the appointment. He will assume active charge of the Society upon the completion of his present academic commitments in June, 1950.

This appointment culminates a series of studies, extending over nearly three years, engaged in not only by the Council and the members of the staff but by a substantial and representative section of the profession—studies that converged upon the problems of this institution and, by necessary implication, upon the scope, opportunity, and limitations of the science and practice of geography. The fundamentals were examined, even the proposition whether in this age of university giants it is any longer necessary or wise to continue to operate an organization devoted to the select purposes of a single branch of learning—whether indeed the whole idea is not an accident of survival in an age of change. The answers to this problem quieted our doubts and cemented our courage. We were told that in large part the functions performed by the Society would perish if scattered to colleges and universities, and that, far from overlapping or competing, we supplement the teaching branches in a positive and essential way. "Without the American Geographical Society," said the head of one of the large graduate schools, "geography in America could not function."

In several directions criticisms arose, to which we gave earnest attention, particularly with respect to the shifting position of the institution in relation to the increase of geographical research in academic centers. Various opportunities for the Society to expand its service to the profession were put forward; for example, through an increased emphasis on problems of the American scene and through a more effective cooperation with the educa-

tional world. We can scarcely hope to follow through on all the potentialities suggested, but the stimulating variety of the proposals, and particularly the loyal belief that they lie within the capacity of the institution, gave a signal to the Council that in its choice of a new Director a great and long-enduring responsibility was involved. The appointment therefore was not made hastily, nor was the field of choice limited to the members of this institution or to the geographers of this nation. The net was flung wide. Out of it came the promising young British scientist now only five years established in his Canadian post.

"Where there is no vision, knowledge and enterprise perish"—to quote Dr. Kimble's own words. That phrase readily characterizes one of the chief requirements of this office, and an examination of the nominee's background and writings confirms, we believe, his fulfillment of the requirement. Educated in the Eastbourne Grammar School, he attended King's College, London, where he received the B.A. in 1929 with First Class Honours in Geography. A year later a degree in divinity was added, and in 1931 the M.A. in geography—all from his Alma Mater. Entering directly into the teaching of geography, he served at the University College of Hull from 1931 to 1936, and at the University of Reading from 1936 to 1939. During World War II, as an officer in the British Naval Meteorological Service for more than five years, he was engaged mainly in investigating the climatic feasibility of the various invasion projects. Early in 1945 he was released by the Admiralty to begin his work at McGill, where he was given a free hand to apply his by now extensive grasp of both theory and practice to the building of a new school of geography. That school has already made its mark, not only at McGill but in the family of geographical centers the world over, and the correlated Summer School at Stanstead, a new and enterprising experiment, has created a comparable impression. Vision, as well as administrative ability, is apparent here. It may be added that, during this time, he completed the work for the Ph.D., which was awarded, *summa cum laude*, by the University of Montreal in 1948.

In scholarship Dr. Kimble has worked in several fields, one of his earliest and most extensive investigations being that of the conceptions of geography held by people during medieval times. His "Geography of the Middle Ages" offers a fine example of integrative thinking on a recondite subject and proves at the same time the author's ability to run tough quarry to earth. Making good use of his work in the war years, he reported extensively on meteorological subjects, both at the time and later. At McGill he has succeeded in building up, in collaboration with the Arctic Institute of North America, a

vigorous Arctic research center, and he is presently editing a cooperative work on the geography of the Northlands. One of the most interesting sides of the man is his willingness to redraw the picture for the benefit of the less highly educated. His treatise "The Weather," priced at 25 cents in the Penguin series, is a best seller on British and American newsstands.

To have vision, a man must possess a philosophy personal to himself regarding the scope and meaning of his subject. We can draft from Dr. Kimble's writings the gist of such a philosophy. "Modern universities," he observes understandingly, "are not alone in their reluctance to accord the subject [geography] full academic honours. The Ancients, for all their enlightenment, could not make up their minds about its significance . . . The scholars of the Middle Ages, the intellectual inheritors of the Ancients, were equally embarrassed." But as to geography's disciplinary integrity, he speaks more firmly. From his inaugural address at McGill: "No forecast involving human elements can be more than a first approximation, and no forecast which does not reveal an expert insight into the normal behavior of those elements need be taken seriously . . . The main business of the geographer is to assess the importance in time and place of those facts or environment that are operative in human affairs, and to apply his findings to contemporary problems. By bringing the study of man 'down to earth' in this way, he claims, not to be able to offer a self-contained system of explanation for man's social behavior and institutions, but to provide one vantage point from which to regard these things."

With a pliant philosophy built upon a scholar's knowledge of geography past and a participant's experience with geography present, Dr. Kimble appears to be amply prepared to assume control of one of the important forces concerned with geography future.

JOHN KIRTLAND WRIGHT

The relinquishment by Dr. Wright of the administrative duties of the Directorship took place last June, after his return from the Sixteenth International Geographical Congress in Lisbon. He had long desired to return to the field of scholarship which originally drew him to the Society, and which had been interrupted or at least seriously interfered with during the eleven years of his Directorship. We admire Dr. Wright for weighing impassively and judiciously the opportunities against the years ahead and making the choice with candor. His service as Director brought him fame, friends, and, we hope, a large measure of satisfaction. The work to which he now devotes

himself will be watched with expectant interest by a loyal host of admirers both within the Society and on the outside.

Most conspicuous of the events of Dr. Wright's span as Director was the war. It takes but a mite of imagination to appreciate what war meant to this organization, how abruptly the routines were smashed, and how the personnel, the equipment, and the great volume of knowledge were diverted to meet the country's need. If example is needed, it may be remembered that no fewer than forty-five government departments tumbled their problems upon us. The adjustment to this avalanche of urgency required skill, tact, and a full understanding of the elements involved, both physical and human. To the management of this period Dr. Wright brought composure and confidence.

Throughout his Directorship he held to the high standards set by Isaiah Bowman in the execution of the Society's programs. The Millionth Map was brought to completion, and the cartographic staff turned to new ventures, such as the Five-Millionth Map of the Americas. The Special Publications and the Research Series were continued along lines already laid down, and openings were made in new fields. A program in medical geography was initiated. An impressive number of conferences significant to geography were conducted under Dr. Wright's guidance and leadership. The appreciation of the profession was shown by his election as President of the Association of American Geographers for 1946.

The task on which he now embarks is the preparation of the history of the Society and its relation to the development of geography. We agree with him that this is an assignment of great importance. For it was during the first century of the Society's existence that the science of geography burst through its confining cocoon, grew wings, and flew out upon the vast fields of work and usefulness it is still busy exploring. Geography, it now seems, leads two lives, the narrower role of procreation within its family orbit and the new, almost boundless service to the sister sciences to which the geographical method can be applied. It will be Dr. Wright's happy duty to give statement to these things, to measure their growth, and by implication to tell us whether the kinetic energy now so plainly visible is here to stay.

GLADYS MARY WRIGLEY

Miss Wrigley's retirement as the active helmsman of the *Geographical Review* has come as a heavy blow despite our watchfulness of the calendar and a perfect realization of its imminence. We shall not say that Miss Wrigley

is indispensable—Wilma Fairchild has already lifted the load with sturdy competence—but the event induces a long, quiet reflection upon the work of one who is a master among a breed of masters.

Gladys Wrigley began her career in geography at the University of Aberystwyth in Wales, under H. J. Fleure, an inspiring teacher, a creative thinker and writer, and the source perhaps for that regard for exact and documented statement and for accuracy in presentation which was to become the trade-mark of her later work. Her studies at Aberystwyth were supplemented by a term in the summer school at Oxford University, and in 1911–1912 she won a scholarship that provided a year in the United States on visits to the departments of geography in our leading universities. Choosing one of these, Yale, she entered the Graduate School and remained for two years, receiving the instruction in geography, history, and anthropology that led to the Ph.D. Her preceptor during those years was Isaiah Bowman.

Thus did Miss Wrigley come inevitably to the Society when Dr. Bowman became Director, her record at Yale having been one of the highest in the department. During her first years with us she had no binding duty but followed the provocative and variable existence of a research assistant. In 1920 she entered upon that task which absorbs all skills and sublimates them into a product peculiar in its anonymity—she became Editor of the *Geographical Review*.

Truly the self-effacement of editors is upsetting. Their calling seems to compel them to abandon identity and mask their being to become as anonymous as the personalities behind the puppet show. Thus one may search in vain through the copies of the journal that have come from her hand to find the author Wrigley, yet she is there on every page, indeed in every line. It is not for the reader to know that—he merely senses the pace, the smoothness, the conjoint result—it is the assembled host of contributors who remember the power of her pen.

Anyone who has ever submitted a manuscript, whether it was accepted or rejected, even many who have merely thought of doing a piece, have been rewarded by bits of the treasure identified with the initials “G.M.W.” It is all there, her story, in the correspondence, and nothing comes to mind so quickly as the tart, penetrating style of her letters, the weapon with which she has fought singlehanded a thirty-year war to bring forth, on time every time, the successive issues of this journal. Dr. Bowman of all persons can best say what this means: “The variety and extent of the editorial correspondence are a tribute to Miss Wrigley’s capacity to stir the imagination of others and inspire them to turn their observations and experiments into

readable accounts of solid professional worth. To conduct such diverse correspondence, accepting here and advising or rejecting there, while still keeping the good will of the correspondent, is a task in diplomacy as well as in scholarship. Hidden in the correspondence is the steady, strong influence of the editor in developing geographers and in spreading ideas through choice of themes and of competent authors. Such discriminating selection requires a trained judgment and a willingness to lose one's self in the work of other scholars. At the same time there is a rich personal reward. The successive numbers of the *Geographical Review* have been influential in a far wider sense than the layman can appreciate. They have profoundly affected the volume and quality of the flow at the source of the geographical river.

"To succeed, it is said that one must run and not be weary, one must walk and not faint. I think that the editor of a scholar's journal would change the phrasing a little and say that to produce the desired effect one must be able to run even if weary and to walk even if faint."

In one of Kipling's poems is the line "Our King asks nothing of any man more than Our King himself has done." The sentiment could be appropriated to describe an editor, who, like a king, must be sleepless as messages come in from lands far and near, day and night. It must be pleasant to receive one new article a day during some months, which has been the experience of Miss Wrigley. So great a wealth of material calls for an unrelenting play of the critical instinct twenty-four hours a day. Whoever heard of an editor's going off on a winter vacation—or a summer vacation for that matter? Miss Wrigley is no exception. During the past ten years she has worked without a vacation of more than a few days. This is tending the light in the watchtower with devotion approaching austerity. The result is reflected in the sustained high quality of the *Review*.

Miss Wrigley continues to serve the *Review* as Editorial Adviser, and that good fortune illuminates a circumstance as meritorious as it is rare. All three of the key figures connected with the Society's rise upon the sky line of international eminence are holding active roles in its affairs today: Archer M. Huntington, President, 1907-1916, conceived the idea and poured the foundations upon which it was built; Isaiah Bowman, Director, 1915-1935, assembled the crew, mixed the scientific mortar, and guided the construction; Gladys Wrigley, Editor, 1920-1949, exercised the leverage of a great scientific journal—these stalwarts, now "Senior Citizens," stand at the core of this organization, fresh and vigorous in thought, steady in experience, loyal in cooperation. Few enterprises have been thus blessed.

RICHARD U. LIGHT

Widening Horizons

The world-wide truth that new times demand new measures is demonstrated in many phases of geographical research, most particularly, perhaps, in the broadened concept of the geographer's increasingly responsible role in the promotion of human welfare, secondarily in the development of new techniques of investigation. The Society's program of studies in medical geography, initiated in 1944 and formulated under the direction of Dr. Jacques M. May in 1948, is an excellent case in point, as will be evident from the present article on methods and objectives and from future reports on specific projects.

**Medical
Geography**

Dr. May combines a deep interest in the problems of man versus environment with a wide experience as a practicing surgeon on four continents. During his eight years in the Asiatic tropics, first as chief surgeon of the French hospital in Bangkok and later as professor of surgery at the Medical College of Hanoi, Dr. May accumulated a wealth of experience, which later formed the basis for a book, published in 1949. "Siam Doctor" is at once a collection of colorful episodes gleaned from a career rich in incident and a stark record of the difficulties inherent in tropical medical practice—barriers of language and custom, lack of sanitation, deficient diet, and, above all, the voracious physical environment. It is to be hoped that two projected sequels, "African Doctor," based on Dr. May's service as a surgeon with the Free French forces in Africa during the war, and "Caribbean Doctor," recording his adventures as chief surgeon of Guadeloupe, in the French West Indies, will be forthcoming.

New horizons have also appeared in the realm of political geography with the change in status of several hitherto dependent areas. Ceylon, which achieved Dominion rank in February, 1948, "not by force or unconstitutional agitation but by persuasion," entered upon its career of independence faced with critical problems (*Pacific Affairs*, March, 1949). However, a hopeful aspect is the procurement by the Ceylon government of the services of numerous expert advisers—engineers, sociologists, medical specialists, industrialists, and so on (*Crown Colonist*, November, 1949)—with the recognition that "undertakings planned without such aid have turned out to be failures."

**A New
Dominion**

The island's economy has long been based on the products of plantation agriculture and therefore has been subject to the vagaries of world markets; the obverse of the coin was the necessity for importing a large proportion of the food supply, generally as much as two-thirds. B. H. Farmer's survey

of agriculture in Ceylon makes clear the urgency of expanding subsistence farming and records the progress of agricultural colonization schemes.

In the industrial world, too, new frontiers are evident, nowhere more spectacularly than in the chemical industries. Here new techniques are the key to development. "Formerly wasted refinery gases, together with natural gas, provide the starting point for a vast array of synthetic organic chemicals, which in turn are the building blocks for many industrial alcohols, solvents, plastics, explosives, detergents, synthetic rubbers, and synthetic fibers." James J. Parsons examines the resource base of the Gulf South's astonishing growth since the war. The excellence of port and other transportation facilities, locational advantages with respect to world markets and trade routes, effective promotional activity on the part of local and state agencies, and—not least—strategic considerations have all been contributory factors in the rapid industrialization of the Gulf States.

The Role of Techniques

The search for fresh fields is not, however, exclusively concerned with the present, or even with the immediate future; often an examination into the past may cast new light on old problems. Such an examination is George F. Carter's evaluation of evidence indicating the presence of early man in Southern California, evidence which suggests that man lived at La Jolla something like 40,000 years ago.

Past and Present

In his description of the Replot skerry guard of Finland, Helmer Smeds deals with a way of life long extant, but on islands generally so little known that they represent "new country" to most American geographers. Here fishing and sealing, animal husbandry, and handicraft industries have supported the islanders since the beginning of recorded settlement in the fifteenth century. But signs of the changing times may be read in land reclamation projects, motorized fishing vessels, regular ferryboat communication with the mainland, and improved living conditions—electric lights were installed in the winter of 1948-1949!

Perhaps the most stimulating of all new horizons lies in the realm of ideas. The mind that creates, explores, interprets, incites, is invaluable to any discipline. Professor Mark Jefferson had such a mind. His death has robbed geography of a pathfinder.

W. B. F.

MEDICAL GEOGRAPHY: ITS METHODS AND OBJECTIVES*

JACQUES M. MAY

WHAT is "medical geography"? What is the substance behind the two words? Is there any substance at all? Is there anything that has not been studied in one of the accepted classic specialties, such as epidemiology or parasitology? This article is an attempt to explain what is meant by the term "medical geography" or the expression "geography of disease." It fully confirms the notion that there is nothing in medical geography which is not based on well-known facts widely scattered through the various branches of medicine. What may be new is the approach to the problems raised by the definition—not the idea that such an approach should be made, since this was understood by Hippocrates—and the method by which the approach can land us on solid earth from the clouds of imagination. The accompanying tabulation (p. 36) is a tentative suggestion as to the specific points that might be investigated.

For many years the attention of physicians has been focused on the symptoms of disease. More recently, with progress in chemistry and physics, attention has been given to the biochemical disorders that are the result of disease. The approach has deepened and explores below the surface. Today we recognize that disease is a multiple phenomenon which occurs only if various factors coincide in time and in space. The focus of interest widens to encompass the relationship between the various factors of this complex and their respective geographical environments. This can be called "medical geography."

THE ELEMENTS OF MEDICAL GEOGRAPHY

What pathological factors enter into the composition of a pathological complex? What geographical factors determine its evolution and behavior?

Medical geography is the study of the relationships between them—the pathological factors, which have been called "pathogens," and the geographical factors, which we propose to call "geogens," and possibly others not listed

*The program of studies in medical geography was financed (1948–1949) by a grant of \$15,000 from the Upjohn Company.

► DR. MAY, head of the Society's Department of Medical Geography, was formerly professor of surgery at the Medical College of the University of Hanoi, French Indochina. His studies of the human response to surgery there and in Siam, Central Africa, and the Caribbean, where he has also worked, led to his present interest in medical geography.

here. Some of these relationships are well known; many have not yet been explored in a sufficient number of cases to have statistical significance. Let us review certain of these factors, mentioning some of the known correlations as we go.

Pathological factors

- 1, Causative agents; 2, Vectors; 3, Intermediate hosts; 4, Reservoirs; 5, Man

Geographical factors

- | | |
|-----------------------------|-------------------------------------|
| 1. Physical | 2. Human or social |
| Climate | Population distribution and density |
| Latitude | Standard of living |
| Rainfall and humidity | Housing |
| Temperature | Diet |
| Barometric pressure | Clothing |
| Sunshine and cloudiness | Sanitation |
| Wind direction and velocity | Income |
| Radiation | Communications |
| Static electricity | Religious customs and superstitions |
| Ionization | Drug addictions |
| Relief | 3. Biological |
| Soils | Vegetable life |
| Hydrography | Animal life, on earth and in water |
| Terrestrial magnetism | Parasitism, human and animal |
| | Prevalent diseases |
| | Dominant blood groups |

Disease is related to the physical environment in numerous ways, of which we shall study only the two principal ones: when it occurs as a result of parasitic infection; and when it occurs as a result of the nature of the water and food ingested. We shall follow up this study with a few specific examples.

DISEASE AS A RESULT OF PARASITIC INFECTION

Animal and plant life multiplies, often using man as its environment and growth medium; a resulting disease is nothing more or less than the human view of the phenomena that ensue. If we can escape from our understandable anthropomorphic bias, such diseases can be recognized as merely the by-product of an accidental collision between two or more forms of life, each pursuing its own destiny.

PATHOLOGICAL FACTORS

1. *Causative agents* are those whose presence actually causes the disease. Their nature is still very much under discussion. Many of them are too small to be seen with a microscope; others can be seen under a microscope but not with the naked eye; still others can be seen with the naked eye. They

are provisionally classified as viruses, rickettsias, spirochetes, bacteria, fungi, protozoa, and metazoa.

Viruses are minute pathogenic organisms exhibiting the highest known degree of parasitism—they cannot exist outside living cells, whereas bacteria, for example, can be cultivated on laboratory media. The size of the viruses ranges from 8 millimicrons (foot-and-mouth disease) to 230 millimicrons (psittacosis). Viruses pass through ordinary fine bacteriological filters; their mode of reproduction is still unknown.

A definite correlation seems to exist between a number of these viruses and temperature, humidity, electrical and magnetic fields, and ultraviolet radiation.¹ The geographical distribution of foot-and-mouth disease in the United States and Mexico and in some Central European countries might be explained by correlation with a yet unidentified geographical factor, as might the periodicity of measles and various other viral diseases. It has been shown² that low temperatures delay the onset of epidemics of sand-fly fever in India, whereas early warm weather usually accelerates outbreaks. Of course, since studies are incomplete, other factors may explain periodicity, such as the rise or fall in the number of susceptibles; but there is a strong possibility that certain local geographical factors are favorable for the growth or multiplication of a virus in the living cell in which it exists. The geographical or locational factor is, indeed, one of the few facts known about some diseases and is reflected in the name given to the disease—for example, Bunyamwera fever, Wumba fever, Semliki Forest fever, Colorado tick fever.

Poliomyelitis seems to be correlated with the seasons, since outbreaks always occur in summer and fall, in both the Northern and the Southern Hemispheres. Gard³ found that an epidemic of poliomyelitis ceases when the temperature drops to 0° C. and flares up again when it rises. The epidemics seem to occur in successive small waves, the peak of which is usually preceded by an increase in rainfall. Whether these climatic factors influence the virus directly or favor its passage from one host to another, thus increasing its virulence, is not yet known.

Pioneer workers in yellow fever noted that a spell of cold weather might

¹ D. G. F. Edward, D. Lush, and R. B. Bourdillon: Studies on Airborne Virus Infections: Killing of Virus Aerosols by Ultraviolet Radiation, *Journ. of Hygiene*, Vol. 43, Cambridge, England, 1943, pp. 11-15; C. R. Levaditi: Comportement des ultravirus hépatiques et poliomyélitiques (souche Lansing) à l'égard des radiations ultraviolettes en milieu fluorescent, *Comptes Rendus Soc. de Biol.*, Vol. 136, Paris, 1942, p. 404.

² H. E. Whittingham: Etiology of Phlebotomus Fever, *Journ. of State Medicine*, Vol. 32, London, 1924, pp. 461-469.

³ S. Gard: Nouvelles recherches sur l'épidémiologie de la poliomyélite, *Bull. Office Internat. d'Hygiène Publique*, Vol. 30, Paris, 1938, pp. 933-952.

affect the course of an epidemic, though this might act upon the vector as well as upon the virus; recent experiments by Bates and Roca-Garcia⁴ show that exposure to high temperatures may hasten the multiplication of the virus of jungle yellow fever in the mosquito *Haemagogus capricornii*. Similar results have been found when the virus is studied in *Aedes aegypti*.

Rickettsias are living organisms slightly larger than viruses and, like them, are completely parasitic and cannot exist outside living cells. Rickettsias are usually found in arthropods and are highly adapted to their hosts. They can be differentiated into three important geographical groups. The Rocky Mountain spotted fever group, linked with ticks, is found chiefly in North America and Brazil, and possibly on the Mediterranean coast of North Africa and the Atlantic coast of South Africa; the Asiatic group, closely linked with mite-borne infections, is found in Japan, South Asia, Formosa, and Oceania, where it causes the tsutsugamushi disease, or scrub typhus; a third group, more widespread, is found chiefly in Europe and Central Asia and is linked with fleas and lice, the former causing endemic, and the latter epidemic, typhus.

"Spirochetes" is the name given to living organisms classified sometimes as bacteria, sometimes as protozoa. They are found throughout the world, but certain species seem to have definite geographical associations. Some live in the blood of man and are transmitted by the bite of lice or ticks. These are common in Europe, Asia, and Africa and have been found in the United States. There seems to be considerable evidence that the species in the Old World and the New are biologically different. Nicolle and Anderson feel that these blood spirochetes of man were originally parasites of small burrowing mammals. This seems to be confirmed by the fact that wild rodents commonly serve as animal reservoirs, especially in California.

Another group passes directly from rodents to man, when man ingests food or water contaminated with the urine of an infected animal (infectious jaundice). A third group needs the bite of the rat to introduce the spirochete into human blood, causing a disease called "ratbite fever." Other spirochetes normally inhabit the tissues of man, causing syphilis, which is widespread, or yaws, which is limited to certain tropical regions, or bejel, localized in the Euphrates Valley, or *mal del pinto*, localized in South and Central America. In all of these transmission seems to be direct, without the help of an obligate vector, though in yaws the fly may help. The factors that

⁴ M. Bates and M. Roca-Garcia: Laboratory Studies of Saimuri-Haemagogus Cycle of Jungle Yellow Fever, *Amer. Journ. of Tropical Medicine*, Vol. 25, 1945, pp. 203-216; *idem*: Development of Virus of Yellow Fever in *Haemagogus* Mosquitoes, *ibid.*, Vol. 26, 1946, pp. 585-605.

produce such a different geographical distribution of organisms biologically so closely related could perhaps be found in the study of the environment of each.

Bacteria are a vegetable group comprising a large number of agents of human disease, most of them widespread throughout the world, causing disease in endemic or epidemic form. From the point of view of medical geography, the endemic aspect is the more interesting and the more deserving of study. Cholera has been observed all over the world in an epidemic form. But endemic foci of cholera from which epidemics spread out are few, limited to certain spots in India and possibly in China. What are the factors that transform endemicity into epidemicity? Similarly, tularemia, a disease of rodents caused by *Pasteurella tularensis* and communicable to man, which was first described in the United States, has been observed also in Europe and Siberia. The causative agent has its propagation in nature assured by a large variety of ticks in all stages of their development. Several rodents harbor the infection; man breaks into the cycle accidentally. In this, as in many other cases, the enzootic largely trespasses on the limits of the endemic. Melioidosis, a disease caused by *Actinobacillus pseudomallei*, has been observed only in Malaya, Indochina, Ceylon, the Netherlands Indies, and China. The factors that confine these bacteria to their present habitation should also be investigated. Many of the factors that govern the passage from endemicity to epidemicity and vice versa are still a mystery.

Fungi are a group of plants related to bacteria, but larger. They are morphologically characterized by the filaments (hyphae) they produce, which branch and intertwine to form a "dense mat of growth,"⁵ the mycelium. They may be multicellular and may multiply either by fission or budding or by means of asexual or sexual spores. Their existence is governed by various factors, such as humidity and temperature, a correlation that may explain their geographical distribution. They are responsible for a number of pathological conditions.

Protozoa are a large group of unicellular animals that cause some of the most widespread tropical diseases, such as malaria (whose causative agent, a plasmodium, is dependent on both man and mosquito for its existence), South American and African trypanosomiasis, and amoebic dysentery. Some of these parasites live independently and may encyst for protection. Others, such as the Trypanosomidae, are probably insect parasites primarily, some of

⁵ N. F. Conant: Medical Mycology, in *Bacterial and Mycotic Infections of Man*, edited by R. J. Dubos, Philadelphia, London, Montreal, 1948, pp. 588-627; reference on p. 588.

climate, water, soil, and cultural habits, and studied their correlations with the pathogen man.

CLIMATE

The influence of climate on man is obvious, but the precise correlations have been only superficially studied. It should be borne in mind, too, that the various elements of climate influence one another; temperature has an effect on evaporation and humidity, for instance, and winds affect temperature. Therefore, when some physiological change is observed in one of the elements of the pathological complex, it may be important to find out whether the change is related to temperature, or humidity, or some other factor. Most of the bodily changes brought about in man by climatic factors are promptly adjusted by the normal play of physiology, and thus only a temporary disturbance is created. The sum total of such adjustments is acclimatization.

Dr. Douglas H. K. Lee⁷ analyzes the scientific study of the influence of climate on man as follows:

"For the first quarter of this century considerations of climatic effect had necessarily to follow one or both of two indirect approaches to the problem. These may be termed the 'survey' method and the 'correlation' method. In the former, more or less systematic examinations were made of persons living under certain environmental conditions, and the results were compared with those obtained by similar examinations of a 'control' population, living under a familiar temperate or 'normal' climate. The difficulties of conducting such surveys on a scientific basis were great, first because there was little information to indicate what types of observation should be made; secondly, because the personnel necessary for an adequate survey were seldom available; and thirdly, because it was difficult to distinguish between the effects of climate per se and concomitant disturbances wrought through infectious disease, malnutrition, economic status, social incentive, and so on. The observation made in this way which most closely met scientific requirements was that of 'basal' metabolism.⁸ This has been meas-

⁷ Personal communication to the writer, October 21, 1949. Some further illustrations of climate-man relations are found in "Clothing for Global Man" by D. H. K. Lee and Hoyt Lemons (*Geogr. Rev.*, Vol. 39, 1949, pp. 181-213).

⁸ E. D. Mason: The Basal Metabolism of European Women in South India and the Effect of Change of Climate on European and South Indian Women, *Journ. of Nutrition*, Vol. 8, 1934, pp. 695-713; W. Radsma: Metabolism during Rest of the European in the Tropics, *Archives Néerlandaises de Physiologie*, Vol. 16, 1931, pp. 91-122; *idem*: Over enkele waarschijnlijke physiologische verschillen tusschen Europeanen in de tropen en in Europa, *Geneeskundig Tijdschr. voor Nederlandsch-Indië*, Vol. 70, 1930, pp. 786-801.

ured on a large number of different groups, and its relationship to climatic factors examined."

In this connection we may cite also the work of Mason and Benedict⁹ in India, Streef and Karmawan¹⁰ in the East Indies, MacGregor and Loh¹¹ in Malaya, and others. In Singapore comparative studies were made of different racial groups living under the same climatic conditions. Europeans, Javanese, and Sikhs showed a basal metabolism rate 5 per cent below normal; Chinese, Malaysians, Punjabis, and Tamils a rate 10 per cent below normal.¹²

Dr. Lee continues: "Unfortunately, the circumstances of measurement, which should be constant for truly comparative studies, are themselves changed by variations in climate, so that the conclusions are open to some doubt.

"The second approach, correlation, is typically the comparison of the variation in some population feature with that of some climatic index (for example, death rate x mean annual temperature). Provided the data are thoroughly reliable and every effort is taken to see that no bias creeps into their selection or use, this method can provide useful evidence. Unfortunately, it is difficult, even now, to get statistical data that are really comparable as regards either content or reliability over large areas. Moreover, it is a human trait to see those groupings that support a conclusion but to regard as unimportant those that do not fit in with an idea. Statisticians are acutely aware of the ease with which significant differences can be read into comparative data where, in fact, no significance exists. Again, the existence of a difference between two sets of data says nothing about the cause of the difference, and in the explanation of differences it is extremely easy to be swayed by preconceptions. Taking the broad view, this type of study must be treated with a good deal of reserve, especially since the reader is seldom in a position to check the argument for himself.

⁹ E. D. Mason and F. G. Benedict: Basal Metabolism of South Indian Women, *Indian Journ. of Medical Research*, Vol. 19, 1931, pp. 75-98.

¹⁰ G. M. Streef and R. Karmawan: Basaal metabolisme in de tropen, zoowel bepaald volgens Krogh als voorspeld uit polsfrequentie en polsdruk [Basal Metabolism in the Tropics as Calculated by the Krogh Method and as Determined from Pulse Rate and Pressure (Read-Barnett Formulas)], *Geneeskundig Tijdschr. voor Nederlandsch-Indië*, Vol. 82, 1942, pp. 72-85.

¹¹ R. G. S. MacGregor and G. L. Loh: The Comparison of Basal Physiological Values in Racial Groups: Part 1, Metabolism, Pulse Rate and Blood Pressure, *Journ. Malay Branch British Medical Assn.*, Vol. 4 (N.S.), 1940-1941, pp. 217-260; *idem*: The Comparison of Basal Physiological Values in Racial Groups: Part 2, Erythrocytes, Haemoglobin Content and Cell Count, *ibid.*, pp. 385-404, *idem*: The Influence of a Tropical Environment upon the Basal Metabolism, Pulse Rate and Blood Pressure in Europeans, *Journ. of Physiology*, Vol. 99, 1941, pp. 496-509.

¹² MacGregor and Loh, The Comparison of Basal Physiological Values in Racial Groups, Part 1.

"The well-known writings of Huntington¹³ date from this period and are based on these methods. They offer many suggestions and stimulate further inquiry, but we must await the production of evidence from the experimental investigators before awarding any final judgment in the matter. The newer experimental approach is essentially threefold: (1) to analyze the practical problem, as it arises in the field, into its component operative parts; (2) to examine each component experimentally under standardized conditions, asking questions, as far as possible, about the effect of one variable at a time; (3) to use the answers and guides obtained by this analysis for a re-examination of the problem in the field. By a repeated turning from the natural, but complicated, problem to an experimental, but somewhat unnatural, study and back again, the real truth is gradually revealed."

Among the climatic factors that have been explored in relation to human health, the most important are heat, light, and humidity. The adjustment of mammals and birds to changes in temperature depends on their temperature regulatory system, which in turn is influenced by many other factors. If this system does not work, overheating and irreversible alterations of the protoplasm occur. In order to combat high external temperature by the loss of as much heat as possible, a peripheral vasodilation takes place, which increases the blood volume at the surface. It looks as though fluids were drawn from the interstitial spaces and transferred into the plasma to increase the dilution of the blood. In the tropics this "wetter" economy¹⁴ results in a slight tachycardia, expressing the increased work of the heart in pumping a greater quantity of fluid. There is also a transfer of red cells from the deeply seated organs to the surface, which causes a certain degree of anoxia of these organs. The anoxia may or may not be compensated, and it is quite possible that in addition to other causes of anemia, which are numerous in warm countries, there may exist a permanent malnutrition of the most important organs.

That arctic climates will kill an unprotected person is obvious; but, again, physiological evidence suggests that, given adequate thermal protection, man may suffer little physiological change in such climates, though major psychological adjustments may be necessary.

Dr. Lee also points out that questions of the suitability of different races

¹³ Ellsworth Huntington: *Civilization and Climate*, 3rd edit., New Haven, 1924; *idem*: *Mainsprings of Civilization*, New York and London, 1945; *idem*: *Principles of Human Geography*, 5th edit., New York and London, 1940.

¹⁴ R. N. Chopra: *Physiology of the Individual in the Tropics*, *Indian Medical Gazette*, Vol. 73, 1938, pp. 40-45 and 102-109 (abstract in *Journ. of Tropical Medicine and Hygiene*, Vol. 41, 1938, pp. 89-97).

to particular climates should likewise be subject to the reservations made above. "Ingenious arguments have been put forward to 'explain' the advantages conferred on dark-skinned races by their pigmentation. Experimentalists, however, are doubtful whether any advantage is conferred, or whether pigmentation has any great significance at all for adaptation."

Freer¹⁵ asserts that the skin of Malaysians has 12 to 15 per cent more sweat glands than the skin of Europeans. Homma¹⁶ states that in certain parts of the body sweat glands are three times as numerous in the negro as in the white. Loewenthal¹⁷ asserts that the superficial circulation is more extensively developed in the black than in the white. The thickness of the skin is also different.

At present we know little about regional or racial differences in electrolytes in the blood. Robinson¹⁸ has found that the sweat of a negro has a lower concentration of sodium chloride than that of a white. The metabolism of potassium seems to be related to the deposition of glycogen in the liver and to the level of calcium in the blood, a high blood calcium being associated with a low blood potassium. Natives of Kenya have a low calcium level;¹⁹ Annamites have a high calcium level, which frequently results in urinary lithiasis. Such variations in the concentration of important electrolytes in the blood could be related, among other things, to food, and through this link to the chemical conditions of the soil; but other factors, such as parasitism, probably play a role. Severe mineral deficiencies may cause disease by themselves (rickets) or may favor the onslaught of germs and thus create a pathological condition.

Regions of scanty sunlight produce diseases that are seldom encountered in tropical countries. Rickets, for example, is common in northern industrial regions where winters are long, but it is rarely found in the tropics, though the diet is poor. Of course, sunshine is not the only factor; an adequate amount of calcium should be provided by the soil if rickets is to be avoided. This mineral is found in certain foodstuffs such as milk and green vegetables and in water. It is interesting to note that the city of Glasgow, one of the

¹⁵ Cited by J. H. Sequeira: Influence of Light and Heat on Human Body, *Kenya and East African Medical Journ.*, Vol. 8, 1931, pp. 332-358.

¹⁶ H. Homma: On Apocrine Sweat Glands in White and Negro Men and Women, *Bull. Johns Hopkins Hospital*, Vol. 38, 1926, p. 365.

¹⁷ L. J. A. Loewenthal: Diseases of the Skin in Negroes, *Journ. of Tropical Medicine and Hygiene*, Vol. 39, 1936, pp. 209-212, 250-251, and 260-263.

¹⁸ S. Robinson and others: Adaptation of White Men and Negroes to Prolonged Work in Humid Heat, *Amer. Journ. of Tropical Medicine*, Vol. 21, 1941, pp. 261-287.

¹⁹ J. B. Orr and J. L. Gilks: Studies of Nutrition: The Physique and Health of Two African Tribes, *Medical Research Council [of Gt. Brit.] Special Rept. Ser. No. 155*, London, 1931.

greatest centers of rickets in Europe, is supplied with unusually soft water from Loch Katrine.²⁰ The mechanism by which rickets occurs through lack of sunlight is now well understood, but other factors probably exist.

WATER

Water is collected in many ways, from holes and scrapes in the ground dug out by the bare hands of thirsty nomadic tribes to the elaborate water-works of civilized cities. Each type of water supply has its special danger.

Water may be contaminated directly, for example by night soil that carries *Endamoeba histolytica*, *Vibrio cholerae*, or *Salmonella typhosa*, or indirectly, as by the laundering of clothes near the margins of wells and streams. It may also harbor intermediate hosts for various flukes. In India and in some other countries where cremation is practiced, the charred remains are placed in rivers. Such customs as this and drinking from consecrated streams result in cholera and other enteric infections. The distribution of step wells as sources of drinking water probably coincides closely with the distribution of dracontiasis. In India and Uganda the water from step wells and ponds abounds in cyclops, which are the intermediate hosts of *Dracunculus medinensis*.

Water that has been treated may become polluted in pipes. In the West Indies the frequent earthquakes are likely to shatter the water distribution system and disrupt the connections, with the result that the polluted soil can infiltrate into hitherto unpolluted water. In Guadeloupe, for instance, a liter of piped water has been found to contain as much as four milligrams of fecal matter. In places where the piped supply is not continuous throughout the day, pollution may enter the empty pipes, to be distributed later to the consumer.

The type of irrigation governs the type of schistosomiasis. In southern Egypt the basin system is prevalent. The land is irrigated once a year. The intermediate host of *S. haematobium* is *Bulinus truncatus*, which is not common under these conditions, and the disease is therefore rare. In the delta of the Nile, however, where perennial irrigation is practiced, *B. truncatus* is common and *S. haematobium* prevalent. On the other hand, *S. mansoni* uses *Planorbis boissyi* as an intermediate host. This snail survives only in permanently quiet water. Consequently, *S. mansoni* is common in the central part of the delta and nonexistent in Upper Egypt. Moreover, *B. truncatus* and

²⁰ Harriette Chick: Diet and Climate (Lecture I), *Journ. Royal Soc. of Arts*, Vol. 83, 1934-1935, pp. 1005-1014; reference on p. 1013.

P. boissyi require water plants on which to attach themselves. They do not live in canals devoid of vegetation.

SOIL

The use of human fertilizer to promote the cultivation of edible plants is possibly one of the greatest single causes of disease in the world. The "fecal peril," as some have called it, covers four-fifths of the inhabited surface of the earth. In North China the excreta freeze on the surface during the winter and are washed out with the thaw; the eggs of many worms and cysts and spores of countless other organisms are spread over the fields.

In India, as in China, bucket latrines are used, and the night soil is collected by untouchables. They dump it into sewers or storage basins, from which it is taken to be used as fertilizer. Finally, promiscuous defecation on the banks of streams, ponds, and rivers leads to widespread pollution and at the same time provides excellent breeding conditions for flies and rodents.

The nature of the soil is also an important factor in the promotion of the life cycle of human parasites. The eggs of *Ancylostoma duodenale*, for example, do not develop well when the soil is dry or contains much chloride. Such is the case in many Egyptian villages. On the banks of the Nile, however, moisture and temperature are satisfactory for the development of *A. duodenale*, and therefore inhabitants of riverbank villages are more frequently infected than inland dwellers. Throughout Egypt this condition is such that the rate of infection averages 50 per cent of the total population of the country, ranging (1939) from 15 per cent in Faiyum Province to 90 per cent in Maasara.²¹

Conversely, the type of soil that favors the development of the eggs of *A. duodenale* is hostile to *Ascaris lumbricoides*. Hence an inverse proportion of infestation by both worms in males and females is usually found in Egypt, where men work in the fields and women stay around the home. In Italy, however, the women work in the fields and the men go into the towns to market the produce; hence women bear the brunt of hookworm infestation and men get the ascarides. Cultural factors, such as less soil pollution and the

²¹ D. L. Augustine, M. Helmy, and M. Nazmi: *Ancylostomiasis and Ascariasis in Egypt*, *Amer. Journ. of Hygiene*, Vol. 11, 1930, pp. 136-148; W. H. Headlee: *Epidemiological Studies of Helminth Infections in an Egyptian Village*, *ibid.*, Vol. 18, 1933, pp. 695-711; J. A. Scott: *Prevalence and Distribution of Hookworm Infection in Egypt*, *ibid.*, Vol. 26, 1937, pp. 455-505; *idem*: *Transmission of Hookworm Infection in Egypt*, *ibid.*, pp. 506-526; *idem*: *Observations on Infection with the Common Roundworm, Ascaris lumbricoides, in Egypt*, *ibid.*, Vol. 30, 1939, pp. 83-116; J. A. Scott and C. H. Barlowe: *Limitations to the Control of Helminth Parasites in Egypt in Means of Treatment and Sanitation*, *ibid.*, Vol. 27, 1938, pp. 619-648; A. T. Shousha Pasha: *Schistosomiasis (Bilharziasis), A World Scourge*, Cairo, 1947.

wearing of shoes (in the case of *A. duodenale*), may change the picture. On the other hand, infection of the soil may be increased if an unabsorptive subsoil makes the drainage system inadequate.

What grows from the soil also has an influence on human disease. Certain plants have allergy-producing pollens; this is a world-wide phenomenon. People can be allergic to the flower of the sugar cane or of the rice plant as easily as to ragweed or timothy. Among the well-known allergies are the various dermatitides, caused mostly by plants of the genus *Rhus*. Allergies are also produced by animals, and allergic phenomena play a part in the symptomatology of the various filariases and of intestinal worms, especially the ubiquitous ascaris.

What lives on the soil has an influence on human sickness. Animal life is, of course, also primarily related to the health of man. The diseases of cattle (tuberculosis), the diseases of rats (plague and rickettsias), the diseases of dogs, cats, and other domestic animals (hydatid disease), and the variety of intestinal worms—each of these is linked with the soil and has its geographical distribution.

CULTURE

Man is also tied pathologically to his culture. Foremost among the cultural factors are those related to religion. The common bowls for washing hands in Buddhist temples spread eye, skin, and other diseases. The daily ablutions of Moslem rites are usually performed with polluted water and contribute to its further pollution. Food tabus, too, have an important bearing on health. Buddhists will not eat the flesh of animals. As we shall see, vegetarian diets, tolerable for the rich, who can compensate their lack of animal protein with milk, eggs, and butter, are disastrous for the poor, among whom malnutrition results. Moslems eat mutton and beef but will not eat pork; thus they are susceptible to tapeworms but protected from trichinosis. Religious pilgrimages have paved the way for many an epidemic; the story of the spread of cholera through the pilgrimages of the faithful is well known.

In the Gilbert Islands superstition compels the inhabitants to deposit their excreta in the sea. This habit results in a certain degree of hygiene and prevents the spread of hookworm. But the sea water is used for its salt; added to the food after cooking, it spreads enteric diseases.

Man's housing also contributes to disease or health. In certain countries the houses are raised above the ground and offer plenty of space for rats, mice, and, in some regions, snakes. In Egypt the roofs of many houses have pigeon cotes, which swarm with rats; plague appears more frequently in

homes in which pigeons are kept than in others. Uncemented stone embankments also attract rats; covering the embankments with mortar has been found helpful in combating plague. When plague strikes in a community, the first cases appear in the vicinity of rivers and basins. The rats flee the embankments in August and September to escape the floods. They take refuge in outlying houses or find shelter in heaps of cotton and maize left in the fields; when the maize is brought in to be dried on the roofs of the houses, the rats follow—and so does the plague.

Japanese houses, generally built of light material, afford little protection against the cold. This explains to a certain extent the prevalence of respiratory disorders in Japan. In winter the floors are covered with mats, which, unless kept clean, are a good shelter for fleas.

Padded clothes such as those worn in the cold desert of North China or in the mountains favor lice infestation; the high incidence of louse-borne epidemic typhus in these areas is noticeable.

Local medicines and medical practices have an influence on disease. Sparganosis, a disease caused by the larvae of cestode worms, may be contracted by the application of poultices made of fresh-killed frogs or other vertebrates, as in Tonkin.²² Such a practice is not, however, confined to Asia. It is still followed in the Mediterranean basin, where fresh-killed pigeons or chickens are believed to cure headache and meningitis when applied immediately to the scalp of the ailing. Tetanus of the newborn is frequent in countries where native midwives dress the cord of the infant with cow dung. Geophagy is common all over Africa. In southern Tunisia it reaches the point of a superstition. The type of dirt preferred is clay, which is found at the margins of rain pools. Half a pound of earth is sometimes consumed by a single person in one day. Addicts accumulate a reserve of choice dirt near their homes and carry pellets of earth with them in their clothing. This should be thought of in connection with the pollution of the soil described above.

In some regions cultural beliefs prevent the penetration of public-health and prophylactic devices. The Moslems are generally opposed to statistics, on the ground that Allah alone should know the exact number of human beings. In Tunisia the control of trachoma is difficult because the examination of female school children is prohibited. In Timor the inhabitants never plant more corn or rice than their ancestors did, since it is believed that to

²²J. Casaux and E. Houdemer: Note préliminaire sur les sparganoses humaines et animales au Tonkin, *Bull. Soc. de Pathologie Exotique*, Vol. 19, 1926, pp. 802-804.

increase the surface planted would be disrespectful to one's father and grandfather. The living starve through respect to the dead.²³

EXAMPLES OF DISEASES RESULTING FROM PARASITIC INFECTION

To illustrate the interrelationships of the various pathological and geographical elements discussed above, it may be helpful to consider examples of two-, three-, and four-factor complexes representing disease as a result of parasitic infection.

CHOLERA

Cholera is a bifactor complex produced when man swallows *V. cholerae*. What follows may depend on whether the juice of the stomach is high or low in hydrochloric acid. In the first case it may happen that *V. cholerae* is destroyed without having a chance to multiply. If the hydrochloric acid content is low, as it is after a meal, the bacillus pursues its way to the intestine, in which it multiplies enormously and liberates quantities of endotoxins, and from which it eventually reaches the outside world again. There the bacilli can be eaten anew in food polluted by the eater's own fingers or those of his associates. Thus the multiplication continues until such time as the weaker individuals have been destroyed and only those with natural or acquired immunity remain, preventing multiplication of *V. cholerae*, and/or until such time as external circumstances—humidity, temperature, or factors yet undiscovered—force *V. cholerae* into dormancy. Unimmunized newcomers and favoring geographical factors may create the phenomenon called a "cholera epidemic." The fate of man in this complex depends on his local and general health. The degree of immunization he possesses, the way he cooks his food, and the manner in which he eats it have also a direct bearing on the fate of the complex.

The problems of cholera in relation to geography are numerous and for many years have attracted researchers. Rogers,²⁴ comparing cholera epidemics for more than 45 years in India, found a definite correlation between failure of the rains and cholera outbreaks, also between absolute humidity and recrudescence and spread of the disease. Chun,²⁵ studying climate and cholera in various Chinese ports, found that each time an epidemic broke

²³ Encyclopædie van Nederlandsch-Indië, article on Timor; M. A. Hartman: Land en bewoners van Alor, Mal en Pantar, *Natuurkundig Tijdschr. voor Nederlandsch-Indië*, Vol. 96, 1935, pp. 59-61; J. C. van Eerde: De volken van Nederlandsch-Indië, Amsterdam, 1921.

²⁴ Sir Leonard Rogers and Sir John W. D. Megaw: Tropical Medicine, 3rd edit., London, 1939.

²⁵ J. W. M. Chun: An Analysis of the Cholera Problem in China, With Special Reference to Shanghai, *Trans. Ninth Congr. Far Eastern Assn. of Tropical Medicine, Nanking, 1934*, Vol. 1, 1934, pp. 399-406.

out the absolute humidity had risen above 0.4 inch, expressed as vapor pressure, which is the figure given by Rogers. However, the reverse does not hold true, and the absolute humidity may rise to this figure without the occurrence of an epidemic of cholera. Nor are the correlations between high humidity and cholera true everywhere. Lal²⁶ has pointed out that they were not confirmed in Calcutta, Lahore, and several places in the United Provinces. In lower Bengal a heavy prevalence of cholera coincides with hot, dry weather. The correlation between epidemics and high temperatures seems to be better established than the correlation with humidity. It was so in Canton in 1937, in Hong Kong, Shanghai, and Macao in 1938, and in Siam and Indochina in 1926 and 1927. However, unusual factors such as migration and influxes of refugees may alter the picture.

In some places, such as Siam, Indochina, and the Netherlands Indies, a lessening of the disease generally coincides with the onset of the rains, which dilute the concentration of germs in bodies of water and seem to play a part in bringing an epidemic to an end. Elsewhere heavy rainfall, especially after a long drought,²⁷ may first increase the number of cases of cholera, because the rivers receive a mass of infection as a result of the downpours.

At one time Emmerich believed that there was a necessary correlation between the nature of the soil—richness in nitrates—and outbreaks of cholera epidemics. In their October, 1948, session, the joint Office International d'Hygiène Publique–World Health Organization study groups on cholera stressed the point that the presence of salt and organic matter is essential to the survival of cholera vibrios. The various microclimates and other ecological factors seem to have different influences in different places. This strongly suggests that the factor which governs the transformation of endemicity into epidemicity has not yet been discovered or that a number of factors operate against one another.

In the study of correlations distinction should be made between epidemic and endemic cholera. Two types of factors may contribute to an outbreak of epidemic cholera: (1) factors that cause the germ in nature or in man to change from a quiescent into a virulent form (such factors could be absolute humidity, presence of other germs, or the little-investigated electrical, magnetic, and radioactive forces); (2) factors that help the spread of the viru-

²⁶ Cited by R. P. Strong: Stitt's *Diagnosis, Prevention and Treatment of Tropical Diseases*, 7th ed., Philadelphia, 1944 (reprinted 1945), p. 605.

²⁷ C. L. Park: The Relation between Geographical Distribution, and Climatic Factors, and Spread of Plague, Cholera, and Smallpox, *Proc. Sixth Pacific Sci. Congr., California, 1939*, Vol. 5, Berkeley and Los Angeles, 1942, pp. 497–518; reference on p. 506.

lent germs (floods, rainfall, human conditions such as migrations, increased density of population, and pilgrimages, etc.).

The factors to be investigated in endemic cholera are those that keep the germ subdued. These may be positive (present) or negative (absent). Then, too, the ecology of the bacillus itself must be studied in relation to two different groups of factors: (1) the germ in man and degree of immunization, diet, bacteriological contents of the intestines (bacteriophage); (2) the germ in nature, where the chemical composition of the soil or of the water, irradiation, temperature, or humidity may affect the form and possibly the strain. If all these factors could be measured and charted in epidemic outbreaks and in the localities where cholera is endemic, and further study be made of the behavior of the bacillus under artificial climatic conditions, some new, enlightening fact might appear.

MALARIA

Let us now take a three-factor complex, such as malaria. Malaria is the human description of a collision between three living organisms: a protozoon, a mosquito, and man. A protozoon of the genus *Plasmodium* is injected into man's system by the bite of a mosquito of the genus *Anopheles*. There it develops, passing through an asexual stage, which includes numerous divisions or schizogonies; finally, after several generations of asexual schizogonies, the parasitic form finds its way into a red blood cell as a sexual individual. There it grows until it fills the cell, which breaks up, liberating the sexual forms into the blood plasma. They are then either destroyed by the lytic powers of the plasma or taken up by an anopheles. Fertilization of the female then takes place, a new individual grows, dissociates the cells of the lining of the mosquito's stomach, and divides into spindle-shaped cells called "sporozoites," which infect all the tissues of the mosquito, including its salivary glands, whence they may be injected into man, and the cycle begins again.

The successful completion of this cycle, although similar in the various species of *Plasmodium*, is considerably affected by numerous factors, which differ for each species. The race of the human host makes a difference—white people imported into a malarial region offer a better medium than natives. The plasmodium is also affected by the immunity that may exist within the host, by his food and the state of his nutrition, and, eventually, by the medicine he takes. Climatic factors—temperature and humidity and probably many others—also influence the life chances of the plasmodium.

The correlation between the malaria complex and heavy rainfall was

used by Gill²⁸ in the Punjab in 1921 to forecast epidemic outbreaks. He showed that high relative humidity provided an environment favorable to the insect carrier, in both the larval and the adult stages. A high degree of correlation between rainfall and relative humidity existed during July and August, and the rainfall data of these two months were utilized as an index of humidity. A marked excess of July-August rainfall suggested the likelihood of an epidemic in the following autumn. Rainfall evenly distributed over these two months was regarded as more favorable for the development of epidemic conditions than heavy downpours toward the end of August, which might wash away and destroy the larvae. Floods during July and August, whether due to local rainfall or to inundation by rivers, were also considered as favorable for the occurrence of epidemic malaria. The spleen rate factor, the economic factor, and a special "epidemic potential" factor of each locality measured by the coefficient of variation of fever mortality over the period 1868-1921 were also used in the forecasting of malaria epidemics.²⁹

SCRUB TYPHUS

An example of a four-factor complex is the tsutsugamushi disease (also called "scrub typhus"). A mite of the subfamily Trombiculinae, a rodent (*Microtus montebelloi* or a related species), a rickettsia (*Rickettsia orientalis*), and man constitute the complex. Before it becomes a disease of man, it exists on the soil as a partial pathological complex, since the adult mite feeds on the juice of the leaves of young grass that has grown in patches of cleared jungle abandoned after temporary cultivation. The larval mite may be brought into the area by birds or by rats in search of food where man has been living. The larval mite sucks the rickettsia from the blood of the rat. It survives through the nymphal and adult stages into the next larval generation. Man enters the diseased area and is bitten. The symptoms he develops are called the "tsutsugamushi disease."

This example illustrates the importance of silent zones of disease—zones where all the elements of disease are present except man. If man steps into these silent zones without immunity and in a receptive condition, the phenomenon of disease occurs. These zones are widespread. The distribu-

²⁸ C. A. Gill: Prediction of Malaria Epidemics, With Special Reference to an Actual Forecast in 1921, *Indian Journ. of Medical Research*, Vol. 10, 1922-1923, pp. 1136-1143; *idem*: The Genesis of Epidemics and the Natural History of Disease, New York, 1928.

²⁹ Satya Swaroop: Forecasting of Epidemic Malaria in the Punjab, India, *Amer. Journ. of Tropical Medicine*, Vol. 29, 1949, pp. 1-17.

tion of anophelines is world-wide, but malaria is conditioned by other factors also and thus exists only in certain places. The distribution of *A. aegypti*, which carries the virus of yellow fever, is considerably wider than the area where yellow fever actually occurs. The presence of rats is reported all over the world, but rickettsias or *P. pestis* has a limited geographical distribution; the three factors, man, agent, and vector, overlap only in certain areas. Rats live where they find food. Poorly protected or inadequate storage places attract rats, which carry rickettsias. In spring the farmer sows wheat, and in summer he harvests typhus. The mapping of these silent zones is of paramount interest to the study of medical geography. Of equal interest is the delimitation of endemic zones, where the complex maintains itself as a whisper between the loud outbreaks of epidemics. The passage from endemicity to epidemicity is one of the most important problems medical geography may help to solve.

DISEASE RESULTING FROM WATER AND FOOD

Hitherto we have dealt with diseases resulting from parasitic infection; now we come to the second main category of diseases—those resulting from properties inherent in the water and food of certain areas.

WATER

Man obtains his water from various sources: underground, from wells and springs; surface, from rivers, lakes, pools, and ponds; atmospheric, from rain. Related to each of these sources are factors producing or inhibiting disease. Lack of iodine in the water of certain regions of Switzerland, for instance, and parts of the Andes, Yunnan, Manchuria, and Argentina,³⁰ is correlated with the distribution of goiter.

The fluorine content of water governs several pathological conditions. If the fluorine content is lower than one part per million, dental caries is common; if much higher, mottled enamel, also called "dental fluorosis," occurs.³¹ In Argentina, in La Pampa, where the fluorine content of the water has been found to range from more than 0.2 milligram a liter to 20 milligrams, 70 per cent of the population over 20 years of age have dental

³⁰ M. Sussini: Aprovechamiento de agua potable en la República Argentina. *Proc. Tenth Pan American Sanitary Conference, Bogotá, 1938*, Washington, D. C., 1939, pp. 406-412; R. Trelles: Existe una nueva enfermedad producida por las aguas de bebida en la República Argentina? *Bol. de Obras Sanitarias de la Nación*, Vol. 3, Buenos Aires, 1939, pp. 603-607.

³¹ Anastasia Van Burklow: Fluorine in United States Water Supplies, *Geogr. Rev.*, Vol. 36, 1946, pp. 177-193.

fluorosis.³² In southern Tunisia the fluorine content of the water is so high that drinking it causes the death of animals and produces exostoses in man.³³

Calcium deficiency in water, as we have seen, may play a role in the distribution of rickets and osteomalacia, or at least combines with other factors to produce them. In some parts of Algeria the water contains so much calcium phosphate and other minerals that it causes gastrointestinal disturbances³⁴ and facilitates the production of stones. On the other hand, as is well known, mineral water is used for therapeutic purposes. In North China and Siberia a low calcium content of the water is found in the regions where Kashin-Beck's disease (a shortening of the long bones and swelling of the short ones) occurs; in fact, the low calcium content exists not only in the water but also in the vegetables grown.³⁵

Water collected from rainfall has a lower mineral content than subsoil water. In the Gilbert Islands the natives obtain most of their water from wells; in the neighboring Ellice Islands rain water is collected. This may account for the fact that the Gilbert Islanders are found to have less dental caries than the Ellice Islands natives. Systematic study of the various waters man uses and correlation with the map of diseases might lead to new discoveries.

FOOD

A well-balanced diet provides calories for energy, a harmonious blending of fats, carbohydrates, and proteins for tissue building, and a satisfactory supply of minerals and vitamins. Few people of the world enjoy such a diet. In certain regions, such as southern India and Bengal, the diet, for economic and religious reasons, is entirely vegetable. As a result, the output of a Bengalese laborer is never, at best, equal to the output of a European or an American. The hill people, who live on a mixed diet of meat, vegetables, bread, and milk, show a completely different physical development. Two tribes living under similar climatic conditions but having different diets show a difference in development, aggressiveness, intelligence, and culture,

³² R. Q. Pasqualini and O. V. Mosto: Fluorine Content of the Water in the Territory of La Pampa, *Rev. Asociación Argentina de Biología*, Vol. 17, 1941, pp. 461-464.

³³ J. E. P. Bernou: De l'action nuisible des eaux selenito-magnésiennes du nord africain et de leur purification (Thèse, Bordeaux, 1897); E. Speder: L'osteopétrose de la fluorose phosphatique de l'Afrique du Nord, *Bull. et Mémoires Soc. de Radiologie Médicale de France*, Vol. 24, 1936, pp. 200-207.

³⁴ Bernou, *op. cit.*; Speder, *op. cit.*; L. Raynaud, H. Soulie, and P. Picard: Hygiène et pathologie nord-africaines, Assistance Médicale, Paris, 1932.

³⁵ E. Tanabe, F. Eto, and T. Furuki: The Iron Content of the Grains and Vegetables Produced in the Regions Where Kashin-Beck's Disease Is Endemic, *Journ. of Oriental Medicine*, Vol. 31, 1939, pp. 175-178.

as well as in resistance to disease. This is illustrated by the famous study of Orr and Gilks of the Masai and Kikuyu tribes in Kenya.³⁶

In certain regions of Eastern Europe, notably Hungary, cereals supply 90 per cent of the carbohydrate content of the diet and 70 per cent of the protein content. The reason is purely economic: more food per acre can be obtained in the form of cereals than in the form of vegetables or animal products.

Other factors influence the type of diet and contribute to the various forms of malnutrition. Land-tenure systems have a bearing. For example, in Egypt three-quarters of the population are agricultural, but only 7 per cent own two-thirds of the arable land. As a result, market demand and not individual preference determines the crops grown, and most of the people do not benefit from the food they raise. Where village ownership is the rule, there is likely to be a lack of incentive for fertilization and erosion control, and here again cash crops overshadow subsistence crops.

In the Balkans religious fasts occur so often and for such long periods as to impair seriously the health of the people: six weeks in Advent, six weeks before Easter, eight to thirty days at St. Peter's feast, and every Wednesday and Friday throughout the year. This results in nutritional deficiencies among the children. During the spring fasts rickets, scurvy, and nutritional anemia are present in the young children, and tetany, xerophthalmia, and keratomalacia in the newborn.

In some places taxes levied on foods make prices prohibitive. In other places starvation is the result of poor distribution—no connections exist between two regions that grow complementary types of food.

In Hungary a correlation is found between the amount of land owned by a family and the amount of bread eaten. In families owning less than one acre bread provides about 66 per cent of the caloric diet. In families owning 10 to 20 acres it provides only 22 per cent; the rest is supplied by fats and animal protein. The low general consumption of meat in Hungary is surprising in view of the wealth in cattle, pigs, and sheep. A survey made in 1934-1935 of 5215 rural families showed that 45 per cent never ate green vegetables and 18 per cent ate no meat; 35 per cent consumed very little milk or none at all. As a result of this deficient diet only 32 per cent of the children of agricultural laborers, 25 per cent of those of artisans, 23 per cent of those of farmers owning their own land, and 8 per cent of those of labor-

³⁶ Orr and Gilks, *op. cit.*

ers without long-term employment could be considered to be properly nourished.³⁷

In places where cassava or sago is the main article in the diet, such as the Moluccas, vitamin B deficiencies are noticeable; the protein and fat content is low. Before the Moluccans came into contact with Western civilization, they complemented their diet with animal food, which provided proteins and fats—caterpillars, worms, maggots, and the like. Since they have been in contact with Western civilization, they have abandoned this part of their diet. As a result, these islands have become an important area of beriberi, pellagra, and bladder stones. Bladder stones are common in many tropical regions and can be explained in the following way. When the protein intake is low, the urea output in the urine is also low. Urea increases the solubility of calcium salts; consequently, on a low protein diet calcium phosphates in the urinary tract are likely to be precipitated. Also, a high protein diet causes the urine to be more acid, a low protein diet causes the urine to be more alkaline and thus decreases the solubility of calcium phosphates. Other geographical factors are also instrumental. Excess of vitamin D because of excess of sunlight may increase the urinary calcium because it increases the absorption of calcium. Lack of vitamin A causes the shedding of urinary epithelium, which forms the nuclei for stones.

Diet explains certain regional dental caries that has been traced to excess of cereals. In Iceland when the people subsisted on meat and fish, as they did for several centuries, there was no dental caries. When improved communications made import of cereals possible, rickets and dental caries appeared.³⁸

A spastic paralysis of the lower extremities, known as lathyrism, is common in Abyssinia and Italy in people with low incomes who must subsist almost solely on chick-peas.

Social, economic, and geographical factors determine the diet of a region and its faults. The faults determine the types of diseases. Pellagra is associated with diets lacking nicotinic acid. It is common in Rumania, Bulgaria,

³⁷ L. G. Michael: *Agricultural Survey of Europe: Hungary*, U. S. Dept. of Agric. Tech. Bull. No. 160, 1930; I. E. Nagy: *Agriculture and the Agricultural Economic Policy of Hungary*, in *Agricultural Systems of Middle Europe*, edited by O. S. Morgan, New York, 1933, pp. 201-250; Harriet Wanklyn: *The Rôle of Peasant Hungary in Europe*, *Geogr. Journ.*, Vol. 97, 1941, pp. 18-35; "National Monographs: Hungary," *League of Nations Publ.*, *European Conference on Rural Life* No. 27, Geneva, 1940; "Rural Dietaries in Europe," *Bull. League of Nations Health Organisation*, Vol. 8, 1939, pp. 470-497; "La situation de la Hongrie en 1938," *Journ. Soc. Hongroise de Statistique*, Vol. 17, 1939, pp. 252-262.

³⁸ Harriette Chick: *Diet and Climate (Lecture II)*, *Journ. Royal Soc. of Arts*, Vol. 83, 1934-1935, pp. 1023-1039; reference on p. 1027.

northern Italy, certain parts of Egypt, and the southern regions of the United States. Rickets is associated with lack of calcium, lack of sunshine, or both.

Lack of sunshine may be self-inflicted. In China women have had their feet bound for many generations. This practice prevented them from taking any outdoor exercise. Living permanently inside their houses, they were, and in some places still are, condemned to late rickets from the time of their claustration, which their many pregnancies gradually transformed into permanent osteomalacia.³⁹

Eating habits are another aspect of culture that has a bearing on the pathological picture. However bad, unsanitary, or unhealthful such habits may be, they are so firmly ingrained that even during famines it is impossible to change them. This was found to be bitterly true in the last famine in Bengal (1945), when many persons starved rather than eat the unknown dehydrated food furnished by relief workers. If wheat is brought into a rice-eating district, most of the people will not eat it; in other places many of the faithful would rather die of starvation than drink milk or eat beef.

DISEASES RELATED TO CERTAIN SPECIFIC FOODS

Another approach to the study of the geographical distribution of disease could be the study of the relationships between certain diseases and certain diets. The diseases could of course be caused by parasitic infection, by the nature of the food ingested, or by both. Let us now give a few examples of these correlations.

MILK

The diseases that derive from the consumption of milk depend partly on the milk itself and partly on the standard of living of the people who consume it. Where the standard is high, the milk is either pasteurized before it is distributed or boiled at home, and the incidence of milk-borne diseases, such as septic sore throat, scarlet fever, and brucellosis, is low. On the other hand, where the standard of living is low, the incidence of milk-borne diseases is high. Further, milk can be polluted with water, with all its infectious possibilities.

Usually, places where cow's milk is consumed are places of high economic standards, and such milk-borne diseases as occur are accidents that have slipped through the tight network of a good public-health system. The

³⁹ J. P. Maxwell and L. M. Miles: Osteomalacia in China, *Journ. of Obstetrics and Gynaecol. of the British Empire*, Vol. 32, 1935, pp. 433-473.

areas of milk-borne diseases are chiefly those where goat's milk or camel's milk is consumed. In the Mediterranean basin we find many foci of brucellosis (Malta fever) and tuberculosis, because of the consumption of raw goat's milk, or diseased cow's milk, or unfermented cheese made with goat's milk. Poor people in Malta, Sicily, Elba, and the eastern basin of the Mediterranean live in close contact with their animals. The foci of brucellosis change constantly, partly because farmers try to sell animals that have aborted as a result of infection, and the disease is thus spread into uninfected areas.

In Somaliland camel's milk is preferred because of its antiscorbutic properties, but it seems to cause constipation, which is a common ailment among nomads living on this milk. In India it is usual before buying milk to dip a finger into it to ascertain the quality. In Africa, the West Indies, and other hot regions where milk has to be transported over some distance, it is occasionally sold sour, with a consequent high bacteriological content.

FISH

Fish can cause human disease both by contact and by ingestion. Contact may be an accident, as when divers and sponge fishermen are bitten. More often fish is a source of disease because it is eaten insufficiently cooked. Some fish (*Tetraodon maculatum*) found near the shores of Japan and the South Pacific islands contain a poison related to muscarine; it is tasteless and odorless and is not destroyed by cooking.

Fish is the intermediate host for a number of helminths, such as *D. latum*; crayfish or crabs for *Paragonimus westermani*. These infestations are common in Japan, Korea, and Formosa, where people eat raw fish, but they can also be found in China, Central Africa, and South America. Primitive tribes of Sakhalin subsist almost entirely on fish. It is buried in pits and covered with earth in summer for use in winter; as a result, one-half to one-third of the population are infested with *D. latum*. In Finland also, a large consumption of fish results in heavy infestation with *D. latum*; the average incidence is 20 to 25 per cent. Oysters and mussels in polluted waters in the Mediterranean spread typhoid among the poorer people, who cannot buy other animal protein and find the shellfish cheap and nourishing food.

RICE

Rice is the food consumed by one-half of the inhabitants of the earth, in certain regions together with other foods, in most regions with whatever

seasoning can be afforded—for example, a little fish—and very often nothing else. The diseases associated with rice can be classified in two groups: those related to cultivation, and those related to consumption.

Asiatic schistosomiasis belongs to the first group. It is caused by *S. japonicum*, which finds in *Oncomelania* its intermediate host. This mollusk is adapted to rice fields flooded with quiet water. When the cercariae come out of the snail, they penetrate through the skin of the farmer as he wades in the mud of his fields. Later they develop into the adult form and lay their eggs under the mucosa of the intestine, from which they are restored to nature through the conveyance of the feces.

The prevalence of malaria is closely associated with the cultivation of rice. Although this statement is true in general, it is qualified by the fact that each region has its own malaria vector and each vector, as we have seen, its own living habits. In the Philippines, for instance, *A. minimus* is the main malaria vector. Its breeding places are the edges of small running streams in the foothills; it is seldom found in stagnant pools. On the other hand, *A. subpictus*, which breeds in the stagnating waters of the rice fields, is a weak carrier, and it has therefore been thought possible to combat malaria in the islands by developing rice culture.⁴⁰

In Malaya the absence of malaria in the rice districts and its prevalence in the hill countries support this view. In Indochina malaria is associated with rice cultivation in some places and not in others. Kerandel⁴¹ has shown that the type of cultivation determines the type of mosquito. If the water in the rice fields is allowed to remain stagnant for long periods, it becomes unfavorable for the breeding of the local malaria vector; but if the rice fields are in terraces or if the water is moving, malaria-carrying mosquitoes breed prolifically.

Robertson and Chang, working in Shanghai, have pointed out that *A. hyrcanus* is found in rice fields much more frequently than in irrigation ditches or pools. They compared rice growing by transplantation and by broadcasting seed. The transplantation method shortened by one month the flooding of the rice fields and thus reduced by one month the chances of anopheline breeding. They also found that the various steps of cultivation—preparation of land, preparation of, and work in, the nursery bed, irrigation, fertilizing, hoeing, and weeding—and flowering and harvest all had an influence on anopheline breeding and malaria. The preparation of the land is unfavorable

⁴⁰ R. C. Robertson and T. L. Chang: Rice Cultivation in Relation to Malaria, *China Journ.*, Vol. 26, 1937, pp. 347–360.

⁴¹ Cited by Robertson and Chang, *op. cit.*, p. 348.

for anopheline breeding during the first two weeks, when the water is being absorbed by the dry soil; later, when the water remains in the saturated field, some anopheline breeding begins, but it is soon interfered with by irrigation and by fertilization with green manure and night soil. Still later, the hoeing and weeding pollute the water, which becomes turbid, a condition that considerably affects the development of the larvae. After the hoeing is done, the rice fields are flooded and left undisturbed. Enormous anopheline breeding ensues and continues during the flowering season, when the water becomes stable and clear five to eight inches deep. Then aquatic plants begin to grow rapidly between the rice shoots, again disturbing the larvae, so that the breeding goes on only along the sunny margins (shade offers an unfavorable environment for many malaria-carrying mosquitoes, and the planting of trees in rice fields has been advocated to combat malaria). After the flowering, the water is withdrawn, and the breeding quickly ceases. After harvesting, breeding is determined by the amount of rainfall; if rainfall is heavy, breeding occurs. The peculiarities of the malaria vectors and agricultural techniques may be put to good use to curb the spread of the disease.

Rice consumption is related to a specific disease, beriberi. This is caused by the lack of vitamin B₁ resulting from the removal of the envelope that contains the vitamin by the grinding and polishing of the rice. In countries where rice is parboiled before pounding or where rice is not the only cereal eaten, the disease is less prevalent. Beriberi has caused a serious health problem in Japan. The present policy is to wash and hull the rice only to the extent of seven-tenths of its weight and to recommend the admixture of barley.

Rice fields are also linked with diseases transmitted by rats, many species of which live in the rice swamps. In Italy, for example, leptospirosis transmitted by rats is a distinct disease of the rice fields.

THE WORLD DISTRIBUTION OF DISEASE

If we attempt to map the pathological regions of the world with the foregoing in mind, we find that the main divisions appear at first glance to be correlated with local diets, cultures, religions, and standards of living. The pattern is not clear-cut, and many of the pathological regions overlap, but the broad picture shows where a disease is prominent.

In the Far East, encompassing the shores of Siberia, Korea, northeast and southeast China, and including the chain of islands that link the Kamchatka Peninsula to Formosa, is a vast temperate region where uncooked crab and

[illegible]

TABLE 1—Continued

THREE- FACTOR COMPLEXES (continued)	Altitude	Latitude	Luminosity	Nebulosity	Water drainage	Rainfall & humidity	Barometric pressure	Temperature	Winds	Radiation	Magnetism	Static electricity	Ionization	Vegetation	Soil conditions	Income	Population density	Housing	Sanitation	Clothing	Diet	Religious customs	Drug addictions	Communications	Animal life	Parasitism	Relation to other diseases	Partial pathogen- cal complexes	Dominant blood groups	REMARKS	PATHOGENS
Leptospirosis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Seasonal correlations have been recorded in various parts of the world. Correlation has been shown between survival of spirochetes and salinity of water in which they live.	Rodent Man <i>Leptospira</i>
Epidemic typhus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Cold weather favors business.	Man Pediculus <i>R. prolesseki</i>
FOUR-FACTOR COMPLEXES																															
Scrub typhus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	The adult mite lives on a certain type of grass, such as the coarse grasses growing on abandoned estates. <i>Fluctulatus</i>	Man Rodent Larval mite <i>Fluctulatus</i>
Tularemia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<i>Dermacentor</i> is vector and also reservoir, since it remains infected all its life; transmits infection to its eggs. The disease may be transmitted directly.	Rodent <i>Dermacentor</i> , <i>Ixodes</i> Man <i>P. tularensis</i>
Trammatode disease Type: <i>Cimex</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Some trematodes do not require a second intermediate host. The cercariae erupt and attach themselves to certain types of aquatic vegetation.	Man Snail Pond Fluke
Cystode disease Type: <i>D. latum</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	The spargana of similar parasites cannot be distinguished.	Man Copepod Fish <i>D. latum</i>
Bubonic plague	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Only bubonic is considered here, since pneumonic plague is usually transmitted from man to man.	Rodent Fluke Man <i>P. pestis</i>
Yellow fever	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Yellow fever seems to be maintained by a dual cycle; jungle yellow fever where the virus is maintained in the primate by a mosquito (<i>Haemagogus</i>) and urban yellow fever spread by the cycle virus <i>Simulium</i> (<i>Aedes</i>).	Man Mosquito Jungle reservoir Virus
Leishmaniasis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Debatable whether the various leishmaniasis should be considered a three- or four-factor complex. In China the dog seems to be an important reservoir.	Man <i>Phlebotomus</i> <i>Leishmania</i> Reservoir (Dog)

*It has seemed preferable, in working out this table, to consider man only in relation to other factors and not as an isolated element, since his response to the various geogens may make him more or less receptive to the actions of the different agents of the complex. For example, housing affects man with regard to malaria but not with regard to clonorchiasis or syphilis.

fish are main articles of diet. Here flourish the liver fluke, *Clonorchis sinensis*; the lung fluke, *P. westermani*; and the intestinal tapeworm, *D. latum*—all of them related to crab or fish.

Westward over the vast expanses of China, India, and Arabia, the shores of the Red Sea, Egypt, and tropical Africa, a region covering about one-quarter of the land surface of the earth, we find what may be called the "empire of soil pollution." Here dense agglomerations of humanity live on dirt, eat dirt, and produce dirt. Here are all the diseases of the bowels—amoebic dysentery, bacillary dysentery, all the intestinal worms. Moreover, in the Yangtze Valley, the Ganges Valley, Madras, and Bombay we find the centuries-old endemic foci of cholera. The land of soil pollution is also the land of rice; and where rice is grown and eaten—except for a few spots where it is parboiled before grinding—the people have beriberi.

The Mediterranean basin, the land of goat's milk, is also the land of brucellosis. In Africa we have diseases correlated with the tsetse fly, the trypanosomiasis. The Atlantic shores of Africa and the shores of Central and South America are the realm of yellow fever, which, however, does not coincide with the empire of its vectors, whose domain extends practically all over the tropical and subtropical world.

In the Americas we find two different pathological regions—Central and South America, and North America. The contrast between them is striking. In most areas of the southern region the pathological picture is still raw, whereas in the north man's labors have altered the picture considerably. Other pathological patterns, such as arthritis, cancer, and high blood pressure, seem to occupy the forefront.

A PROGRAM OF RESEARCH

To illustrate the foregoing, the accompanying tabulation has been set up.

Diseases taken as examples are classified in two-, three-, and four-factor groups and listed in horizontal columns. Geogens are listed in vertical columns. When a correlation between a pathogen and a geogen seems positively established, a plus sign is inscribed in the square corresponding to the intersection of the columns. A minus sign indicates that no correlation appears to exist at the present time. A question mark shows that the correlation needs to be investigated.

The present list of geogens is completely arbitrary. Other factors could be added; some could probably be condensed.

The tabulation as a whole is an attempt at a census of our present knowl-

edge of medical geography. Some of the unexplored correlations could be investigated in the field or in experimental stations where climatic geogens could be artificially produced.

A program of research should comprise:

1. A census of what is known and a discussion of every problem suggested by the tabulation.
2. The study of a disease, taken as an example of the endemic-epidemic type, against its environment.
3. The study of a region with reference to the diseases it produces. This should include sample studies of population, in order to work out a reliable statistical method for the computation of the prevalence of diseases. Such a plan is now being developed at the American Geographical Society.

UNDERDEVELOPED COUNTRIES AND MEDICAL GEOGRAPHY

The President of the United States has declared his intention to lead the country into a new program for the advancement of backward areas of the world. When the time comes to enforce this policy, there will be a demand for facts about these backward areas. The question will be asked, what makes people backward? What causes countries to be underdeveloped? For much of the tropics, at least a partial answer can be given. The soil produces poor food, the pathogens cause poor health, both are the cause of poor working efficiency, all operating in a vicious circle. An outsider breaking into the environment would be fed its food and inoculated with its parasites, unless he brought with him the techniques by which Western civilization has triumphed over difficulties of nature.

In China, Indochina, India, Central Africa, and Central America, for instance, parasites and food combine to give the inhabitants a chronic anemia, which causes anoxia of organs and tissues. If unusual effort or exertion is made, asphyxia soon results. The people most heavily infested with parasites are also underfed. With these terrific handicaps, they cannot develop their intelligence and culture, cannot organize agriculture profitably or develop commerce and industry or the arts of social living. They are, consequently, in no position to establish institutions by which they could raise their standard of living, organize sanitary campaigns, and achieve public health. Since they cannot get rid of their most despotic tyrants and oppressors, the intestinal worms and blood parasites, they are tied down by their physical condition to their backward status. Medical geography could become a preliminary step to the redemption of backward countries throughout the world; for, in

our final definition, it is the systematic study of the correlations that exist between the diseases of the land and the diseases of the people.

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AGRICULTURE IN CEYLON

B. H. FARMER

GEOGRAPHICAL literature on Ceylon is now fairly abundant;¹ nonetheless, there are several reasons for attempting at this time a discussion of some geographical aspects of agriculture on the island. In the first place, agriculture is, and indeed must be, the foundation stone with which Ceylon begins to build its career as an independent country,² so that some evaluation of agricultural resources is timely. In the second place, a survey today will be a yardstick with which to measure the great changes both in agricultural activity and in land use that will undoubtedly accompany independence. In particular, the drive toward greater home production of food will be accelerated, a drive that has already gained momentum since the attainment of partial self-government in 1931. This policy does not spring from mere nationalism but is, among other things, a sensible reaction to the depression of the 1930's and to the general rice shortage of the war and postwar years. Both showed the danger of an economy in which some 60 per cent of the primary foodstuff had to be imported from Burma and other regions liable to be cut off by war or disorganized by civil strife and had to be paid for by export of plantation products subject to wild fluctuations of price.³

In the third place, a survey today can, for the first time, make use of reasonably accurate and comprehensive statistical data, though information on yields is still incomplete. The 1946 Census of Agriculture⁴ gives crop

¹ In particular, the author wishes to record the stimulus derived from Elsie K. Cook's pioneer work "A Geography of Ceylon," Madras, Bombay, etc., 1931; and from S. F. de Silva: *The New Geography of Ceylon* [4th edit.], Colombo, 1947. See also W. I. Ladejinsky: *Agriculture in Ceylon, Foreign Agriculture*, Vol. 8, 1944, pp. 3-20, and the *Bulletin of the Ceylon Geographical Society*.

² Ceylon became a self-governing Dominion within the British Commonwealth on February 4, 1948. For an interesting account of the process by which this status was attained see [Sir] W. Ivor Jennings: *The Dominion of Ceylon, Pacific Affairs*, Vol. 22, 1949, pp. 21-33.

³ See Sir Alan Pim: *Colonial Agricultural Production*, London, New York, Toronto, 1946, pp. 59-71; Sir Ivor Jennings: *The Economy of Ceylon*, Madras, 1948 (see review in *Pacific Affairs*, Vol. 22, 1949, pp. 316-317); Shannon McCune: *Sequence of Plantation Agriculture in Ceylon, Econ. Geogr.*, Vol. 25, 1949, pp. 226-235; also J. C. Frieberg: *Ceylon's Food Supply, Tropical Agriculturist*, Vol. 93, 1939, pp. 325-329, and Vol. 94, 1940, pp. 3-9. The *Tropical Agriculturist* is published by the Department of Agriculture, Peradeniya, Ceylon, and contains much material of geographical interest.

⁴ Published as *Ceylon Government Gazette (Extraordinary)* No. 9764, Colombo, Sept. 16, 1947.

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acreages and certain other information⁵ for each of the 110 small administrative units of the island with what is considered a high degree of accuracy. Previous statistics were, with the exception of those concerning plantation crops and areas under government irrigation works, only very rough estimates. Maps of crop distributions could, it is true, be laboriously compiled from the one-inch topographical maps of the Ceylon Survey Department⁶ or from its quarter-inch agricultural map (1927). But such distribution maps were never up to date and never reflected simultaneous conditions over the whole country.

In this paper rather more attention will be devoted to the peasant than to the planter. Many of the facts about plantation agriculture in Ceylon are readily accessible; and it is to the peasant that official interest is increasingly turning, though for many years to come the planter will be the main contributor to the export trade.

LAND AND CLIMATE

Ceylon consists almost entirely of crystalline rocks.⁷ The only exceptions are the Miocene limestones of the Jaffna Peninsula and of a narrow belt down the west coast to Puttalam, the sands of the eastern and western littorals, and a few minor spreads of alluvium. There are none of the volcanic, and few of the alluvial, materials that in a more favored region such as Java resist the leaching associated with soil formation in the humid tropics. As Figure 3 shows,⁸ much of Ceylon seems to be covered with laterites and lateritic loams, though nonlateritic loams appear in drier areas. None of the soils, however, are particularly fertile under natural conditions.

The Jaffna limestones have resisted laterization and are mantled with red and gray loams of terra rossa and rendzina type. The sandy soils of the eastern and western littorals are good for coconuts but for little else. Certain

⁵ Much help in the interpretation of data has been given by the Minister of Agriculture and Lands' Colombo, and by the staff of the High Commissioner for Ceylon in London.

⁶ For example, the map by A. Ginigé in Cook, *op. cit.*, p. 178.

⁷ F. D. Adams: The Geology of Ceylon, *Canadian Journ. of Research*, Vol. 1, 1929, pp. 425-511; J. S. Coates: The Geology of Ceylon, *Ceylon Journ. of Sci.*, Sect. B, Vol. 19, 1935, pp. 101-187; and L. J. D. Fernando: The Geology and Mineral Resources of Ceylon, *Bull. Imperial Inst.*, Vol. 46, 1948, pp. 303-325.

⁸ After A. W. R. Joachim: A Review of Progress in the Study of the Soils of Ceylon, *Proc. First Annual Sessions, Ceylon Assn. of Sci.*, Part 3, Colombo, 1945, pp. 21-30 (summary, "The Soils of Ceylon," *Bull. Ceylon Geogr. Soc.*, Vol. 2, 1947, pp. 12-18) (see the note by Shannon McCune, *Geogr. Rev.*, Vol. 37, 1947, pp. 500-501). Also a series of papers by A. W. R. Joachim, S. Kandiah, and D. G. Pandittesekere, *Tropical Agriculturist*, Vol. 84, 1935, to Vol. 98, 1942.

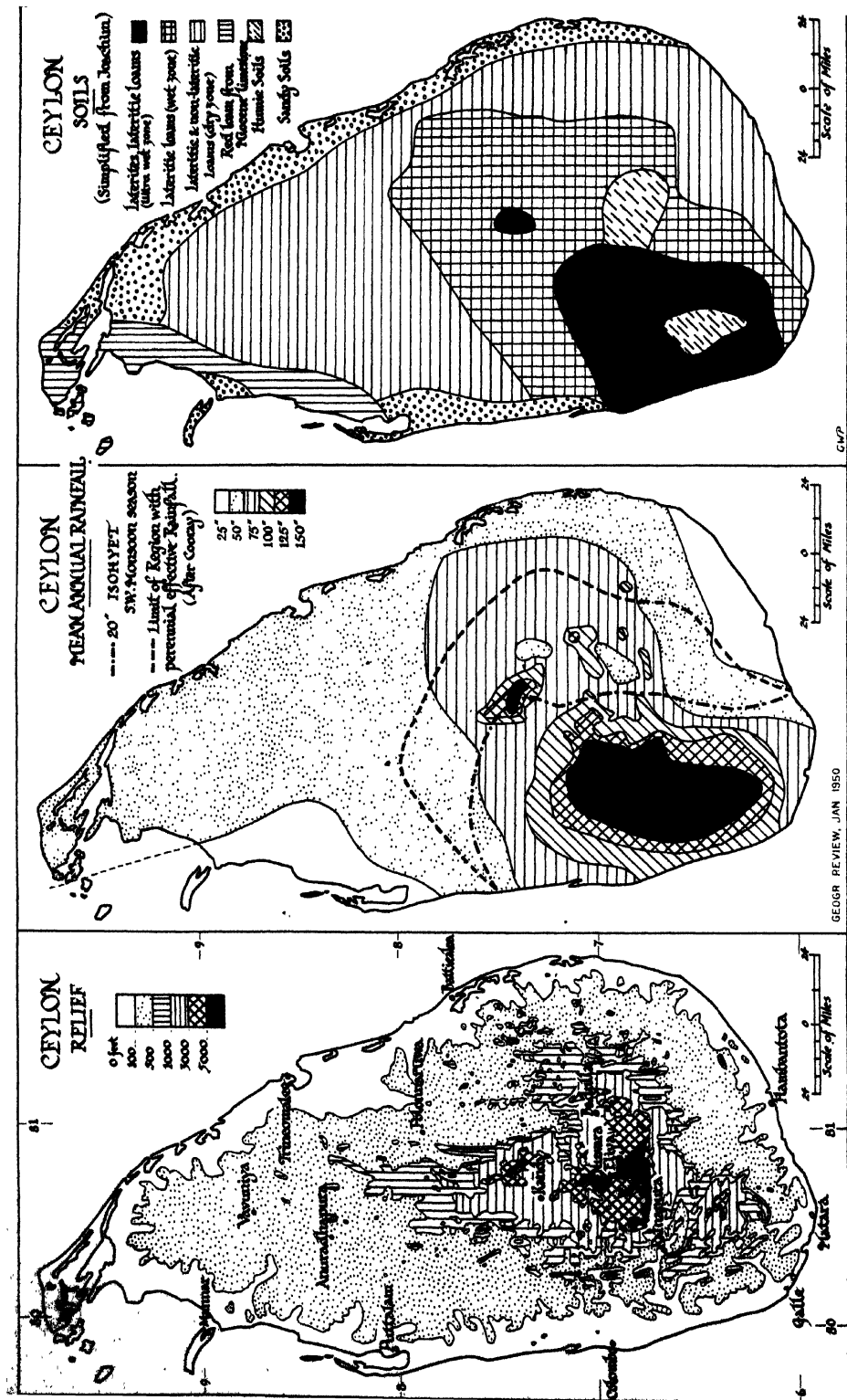


FIG. 2

FIG. 3

naturally and artificially flooded areas have azonal clays and loams, and humic soils occur under the highland patanas (grasslands) and fernlands.

The highlands of south-central Ceylon rise to more than 8000 feet, and among them are prominent scarps that represent the drop from one old peneplain surface to the next.⁹ The highland mass is, of course, the reason for the climatic amelioration and easily drained slopes that attracted nineteenth-century planters. But it is also the source of many problems. Communications are difficult, and there is little flat land available for paddy cultivation unless terraces are constructed. The steep slopes are liable to soil erosion when stripped of their original forest cover and planted with tea or rubber. As long ago as 1914, J. C. Willis¹⁰ attributed the rapid silting of certain rivers to this cause, and floods today are often serious. Increasing attention is being given to remedial measures, but in many areas erosion is in an advanced stage.¹¹

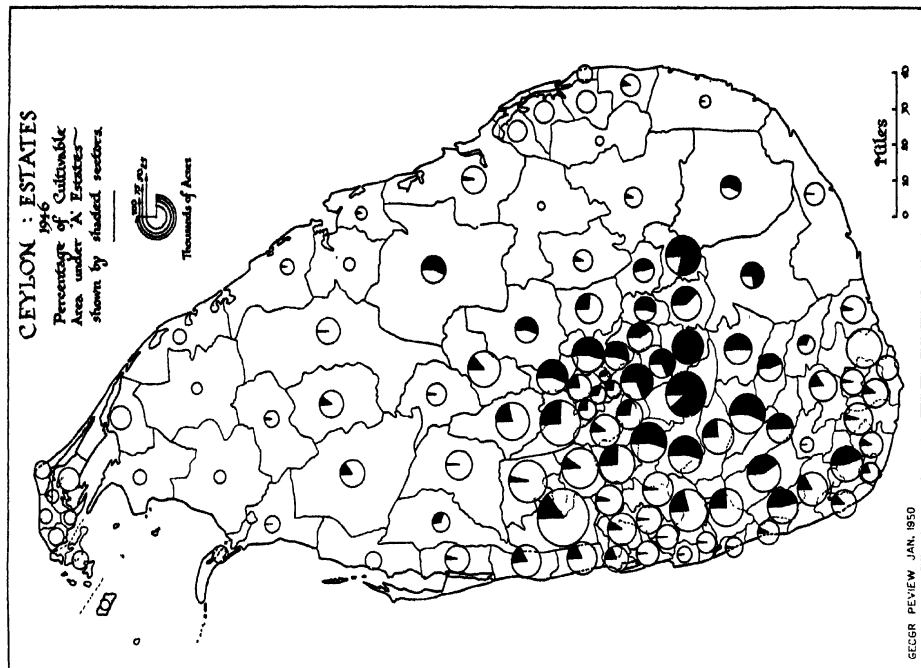
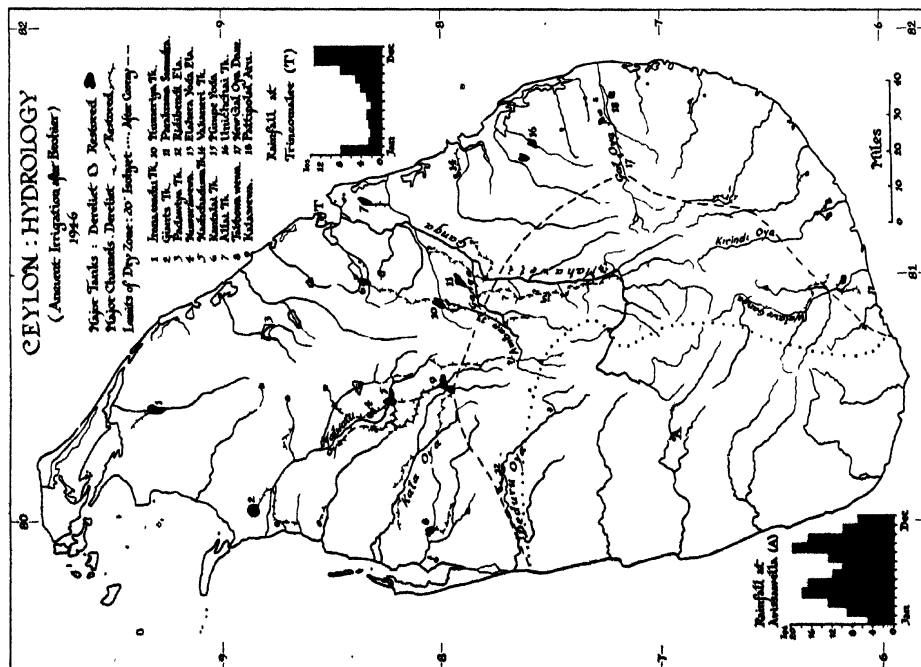
The influence of relief is not confined to the highlands. An atlas gives the impression that the northern part of Ceylon is a level plain; but actually it is traversed by a series of long, narrow strike ridges that effectively seal off each river basin from its neighbors and preclude the construction of irrigation works comparable with those of, say, the Punjab. There are, moreover, no really large continuous areas suitable for paddy cultivation, except in the coastal plain behind Batticaloa. Even more accidented is the relief of the Bintenne, southwest of Batticaloa; and the hinterland of Colombo and the coastal belt southward to Galle do not form a smooth plain. Everywhere relatively narrow valleys are separated by low, rounded lateritic hills, so that the amount of paddy land is clearly limited. In fact, it is common in Ceylon to divide peasant land into two classes, paddy land and "high land," i.e. the nonirrigable interfluves on which other crops have to be grown.

Graver, however, than the difficulties due to geology, soil, and relief are those presented by climate, though, of course, tropical temperatures make possible the astonishing ease with which plants grow, given adequate moisture. Ceylon is, very broadly, subject to two main climatic influences, the southwest monsoon of May to September and the northeast monsoon of

⁹ Three such peneplains are usually recognized, but much work remains to be done before their origins and mutual relations can be established. See Adams, *op. cit.*, and D. N. Wadia: The Three Superposed Peneplains of Ceylon, *Ceylon Dept. of Mineralogy Records, Professional Paper No. 1*, 1943, pp. 25-32.

¹⁰ In "The Oxford Survey of the British Empire," Vol. 2, "Asia," edited by A. J. Herbertson and O. J. R. Howarth, Oxford, 1914, pp. 338-371 (Chapter 11).

¹¹ For soil erosion see also T. Eden: Elements of Tropical Soil Science, London, 1947; W. C. Lester Smith: Soil Erosion on Tea Estates, *Tropical Agriculturist*, Vol. 91, 1938, pp. 280-285; and F. A. Stockdale: The Chena Problem and Some Suggestions for Its Solution, *ibid.*, Vol. 66, 1926, pp. 199-208.



November to March. The former brings heavy rain to the southwest (Fig. 2) but less than 20 inches to the rest of the island. This comparatively low rainfall coincides with high temperatures; for instance, the mean July temperature at Jaffna is 84° F.; at Trincomalee, 84°; Colombo, 81°; Kandy, 77°; and Nuwara Eliya, 61°. Consequently, evaporation greatly exceeds precipitation. P. G. Cooray¹² considers that soil moisture falls below wilting point over about two-thirds of Ceylon in June and July. During the northeast monsoon, however, the north and east in general receive more rain than the southwest, and in all but small areas rainfall is adequate to plant growth.

There is thus a fundamental contrast, long recognized locally, between the "wet zone," with adequate rainfall at all seasons, and the "dry zone," with a shortage during the southwest monsoon. The contrast, in spite of the small size of the island, is sharp. The 20-inch isohyet for the five southwest-monsoon months is often taken as the limit of the dry zone, which would thus include the highlands east of the meridian of Nuwara Eliya and, in particular, the upland Uva Basin around Badulla. To use this limit, however, is to disregard the lower temperatures, and hence the higher effective rainfall, in the highlands, and this paper, following Cooray, will use "dry zone" for the area having at least two months in which soil moisture falls below wilting point (Fig. 2) and "wet zone" for the rest of the country. Within each zone there are, of course, many local variations. Thus within the wet zone the Uva Basin and Minipe area (Fig. 4) are characterized by a maximum of rainfall during the northeast monsoon, and paddy cultivation usually depends on irrigation. Finally, variability of rainfall is a problem to be reckoned with, and many marginal areas of the wet zone are deficient in enough years to make irrigation necessary.

IRRIGATION

The dry zone of Ceylon is completely dependent on irrigation for cultivation during at least part of the southwest monsoon. From very early times, the Sinhalese constructed irrigation works ranging in complexity from simple dams to great systems of interlinked reservoirs (Fig. 4).¹³ During the last few centuries before Christ and the early centuries of our era a great civilization flourished in the dry zone, and its splendid memorials are still to

¹² In an important but necessarily preliminary paper, "Effective Rainfall and Moisture Zones in Ceylon," *Bull. Ceylon Geogr. Soc.*, Vol. 3, 1948-1949, pp. 39-42.

¹³ See R. L. Brohier: *Ancient Irrigation Works in Ceylon*, 3 vols., Colombo, 1934-1935. For modern conditions see the Administration Reports of the Director of Irrigation, Colombo. See also R. L. Brohier: *The Tamankaduwa District and the Elahera-Minneriya Canal (The History of Irrigation and Agricultural Colonization in Ceylon)*, Colombo, 1941, and the *Geogr. Rev.*, Vol. 33, 1943, pp. 671-672.

be seen; for example, at Anuradhapura and Polonnaruwa.¹⁴ According to the usual version, the Sinhalese were overwhelmed by waves of Tamil invaders from the north and eventually retreated to the wet zone and to the highlands, leaving an almost empty belt, the "Wanni," between them and the Tamils, who had settled in the north. The great irrigation works fell into decay,¹⁵ and malaria, apparently absent in earlier times, became endemic.¹⁶ Mosquitoes found ideal breeding places in untended irrigation works and in the shallow pools that lingered in otherwise dry watercourses during the southwest monsoon.

The problem of irrigation in the dry zone of Ceylon is not an easy one. Most of the rivers rise within the zone and become dry during the southwest monsoon. Their resources then consist only of the water that could be ponded back and saved during the northeast monsoon. The Mahaweli Ganga fortunately rises in the wet zone, and it and its main tributary, the Amban Ganga, are perennial. The ancient Sinhalese, with great skill, and using mainly strike depressions, took Amban Ganga water by means of the Elahera Yoda Ela (channel) to supplement dry-zone rivers and to feed the lakelike tanks of Minneriya and Kantalai. Mahaweli Ganga water was perhaps taken by the Minipe Yoda Ela to the great tank known as Parakrama Samudra ("Parakrama's Sea"; Parakrama Bahu the Great reigned in Polonnaruwa 1153-1186), but rugged topography prevented, and still prevents, the construction of such a system on the right bank of the river. A similar great system, designed to feed tanks in the region of Anuradhapura, took water from the wet-zone headwaters of the Kala Oya, and perhaps even from the Amban Ganga.

Great strides have been taken in the restoration of tanks, and a start has been made in the restoration of the channels, but many dry-zone peasants still depend on derelict or unrestored tanks. Few major schemes have broken completely new ground, though work has begun on a large dam on the Gal Oya that will irrigate 132,000 acres, equivalent to half the area already irrigable by government works; and other projects are under consideration. But quite aside from other considerations, there are obviously many limiting physical factors.

¹⁴ H. W. Codrington: *A Short History of Ceylon*, London, 1939.

¹⁵ For the contrary view, that the decay of the tanks, brought about by soil erosion and siltation, was the cause and not the effect of the collapse of the ancient Sinhalese civilization, see H. I. S. Thirlaway: *Ruhuna and Soil Conservation*, *Loris Journ.*, Vol. 3, Colombo, 1945, pp. 1-5. It would seem, however, that more evidence is needed on this point.

¹⁶ See K. J. Rustomjee: *Some Observations upon the Epidemiology of Malaria in Ceylon*, *Ceylon Sessional Papers*, XXIV of 1944. A map shows the close correspondence of the area of endemic malaria with Cooray's dry zone.

Conditions are different in the Jaffna Peninsula. There the permeable limestone and the absence of surface drainage preclude tank construction, and, instead, shallow wells are dug down to the water table. The water is lifted manually. Power pumping is being applied here and there, often by cooperative societies, but it has its limits, since brackish water from the sea soon enters an overpumped well.¹⁷

There is no need for elaborate government irrigation works in the wet zone, though water taken directly from perennial streams by local, village works is used in paddy cultivation. However, the very dampness of the climate is a drawback here; for there is no long, sunny ripening season, as in, say, Burma,¹⁸ and flooding presents hazards.

GENERAL DEGREE OF LAND USE

Figure 5 shows the distribution of "cultivable" land according to the 1946 census. The term "cultivable" as there used applies only to that land which had actually been cleared and otherwise made available for cultivation in 1946; it in no way refers to any possible future extension of cultivation. In this sense, only 4,237,504 of Ceylon's 16,023,229 acres, little more than a quarter, were cultivable. As might be expected, the distribution is uneven. Over the whole dry zone less than 10 per cent of the land is cultivable except on the Jaffna Peninsula and the adjoining mainland, on Mannar Island, in parts of the triangle between Puttalam, Anuradhapura, and Polonnaruwa, and in a strip along the east coast south of Batticaloa. With such a hinterland it is not surprising that Trincomalee, though possessed of the finest natural harbor in Ceylon, has hardly any commercial traffic. There is also a belt of little-used land along the eastern edge of the wet zone, except for the Uva Basin; and in the southernmost highlands south of Ratnapura.

The highest percentages of cultivability (more than 80 per cent) occur in a rather narrow strip down the west coast, from Chilaw, some 40 miles north of Colombo, to Matara, and in a broader belt stretching inland from the Colombo-Chilaw coast to Kandy. The highest figures of all are reached in a few small areas just west of Kandy, in spite of the high relief and the steep slopes, and in the immediate hinterland of Galle; in both these regions more than 98 per cent of the land is cultivable.¹⁹ There is thus a striking difference in degree of land use, and consequently in population density, between most parts of the wet zone and most parts of the dry zone.

¹⁷ See *Administration Report of the Director of Irrigation for 1946*, Colombo, 1947, p. 6.

¹⁸ See the editorial on the rice crops of Burma and Ceylon, *Tropical Agriculturist*, Vol. 93, 1939, pp. 255-256.

¹⁹ For sizes of holdings in the wet zone see Jennings, *The Economy of Ceylon* (*op. cit.*), pp. 56-57.



FIG. 6—Unichchai Tank in the dry zone of eastern Ceylon. Typical residual hills of the catchment area in the background. (Photograph by S. V. O. Somander, Batticaloa.)



FIG. 7—Trampling paddy near Batticaloa. Moslem women are working under the eye of a *podiar* (landed proprietor) with umbrella. (Photograph by S. V. O. Somander, Batticaloa.)



FIG. 8—An up-to-date tea factory in Ceylon, ideally situated and served by road and rail. (Photograph by courtesy of the British Information Services, New York.)



FIG. 9—Coolies loading bullock carts with cases of tea, Ceylon. (Photograph by courtesy of the British Information Services, New York.)



FIG. 10—Tea in the Uva Basin. Note the steep slopes and the trees, which reduce soil erosion. (Photograph by D. Brown.)



FIG. 11—Coconut estate near Negombo in an area of many coconut estates on the west coast between Colombo and Puttalam. (Photograph by J. C. F. Kirkman.)



FIG. 12—Terraced paddy lands near Kandy. (Photograph by D. Brown.)



FIG. 13—Cultivating mudded paddy fields near Kandy. Cooperative cultivation by a group of villagers. The field is on a minor flood plain between low, lateritic hills on which grow coconut and other trees. (Photograph by J. C. F. Kirkman.)



FIG 16—Paddy harvest in the dry zone Near Vavuniya, about 30 miles north of Anuradhapura. The paddy fields are below a minor tank, whose bund appears in the middle distance on the right. Note the dry-zone trees. (Photograph by J. C. F. Kirkman.)

FIG 17—Paddy at Tissamaharama. This is a fairly extensive area of paddy watered from Tissa Wewa. (Photograph by J. C. F. Kirkman.)



FIG 14—Animals are grazing on the floor of a tank near Anuradhapura. The impounding bund of the filled tank can be seen in the middle distance. A typical dry-season scene. (Photograph by J. C. F. Kirkman.)

FIG 15—Tissa Wewa (or tank) is a large one, fed by a channel from the Kurundi Oya, in the dry zone near Hambantota. (Photograph by J. C. F. Kirkman.)



CEYLON'S "DUAL ECONOMY"

Ceylon has what may be somewhat loosely termed a "dual economy." But it is a gross oversimplification to interpret this as two distinct economies, one indigenous and devoted entirely to subsistence production, the other alien and devoted entirely to production for sale. Probably many peasant families sell only a very little of their produce for cash, though details are sadly lacking.²⁰ And most European-owned plantations grow relatively little food. But many peasants today grow *some* crops for cash, and an increasing number of plantations, or estates, as they are known in Ceylon, are owned by men who are, if not peasants, at least Ceylonese. It was estimated in 1934 that about 90 per cent of the capital invested in coconut estates, about 55 per cent of that in rubber estates, and about 20 per cent of that in tea estates had been invested by Ceylonese.²¹

For convenience, however, crops grown mainly on estates and those grown mainly on peasant holdings will be considered separately.

THE ESTATES

Figure 5, based on the 1946 Census of Agriculture, shows the percentages of the cultivable area in "A" estates. By definition, these are 20 acres or more in extent, have ten or more resident laborers, and returned census schedules in English. In general, the map demonstrates the significance of the European-owned estate, of fair or large size, and worked by hired labor, usually Indian. However, some state farms and similar projects are included, as are Ceylonese-owned estates that returned schedules in English. Seemingly this accounts for the relatively high percentage in Tamankaduwa Palata, the large dry-zone division that includes Minneriya and Polonnaruwa.

The highlands around Nuwara Eliya and the Uva Basin around Badulla have the highest percentages of their cultivable land in "A" estates. In the immediate vicinity of Nuwara Eliya, the percentage reaches 98. There are somewhat lower percentages in the Kandy District, a region of distinctive Sinhalese settlement, and in the Ratnapura and Galle hills and valleys. There are hardly any estates in the dry zone.

Tea. Of the 533,830 acres under tea in 1946, 456,580 acres, or about 85 per cent, were in "A" estates. The two densest concentrations are in the

²⁰ See Jennings, *The Economy of Ceylon* (*op. cit.*), pp. 56 ff., for a discussion of the facts revealed by some of the series of economic surveys that have been conducted by the Ceylon Ministry of Labour, Industry and Commerce.

²¹ Jennings, *The Economy of Ceylon*, pp. 25-26, from the Report of the Ceylon Banking Commission, *Ceylon Sessional Papers*, XXII of 1934.

Nuwara Eliya and Badulla estate areas, with a strip along the railroad line between them (see Fig. 18, which shows the total area under tea). Here, indeed, there is true monoculture of tea on estates that are still largely European-owned. Less dense concentrations spread north and east of Kandy, and a little tea is grown in the hills behind Galle and Matara. In general, most plantations

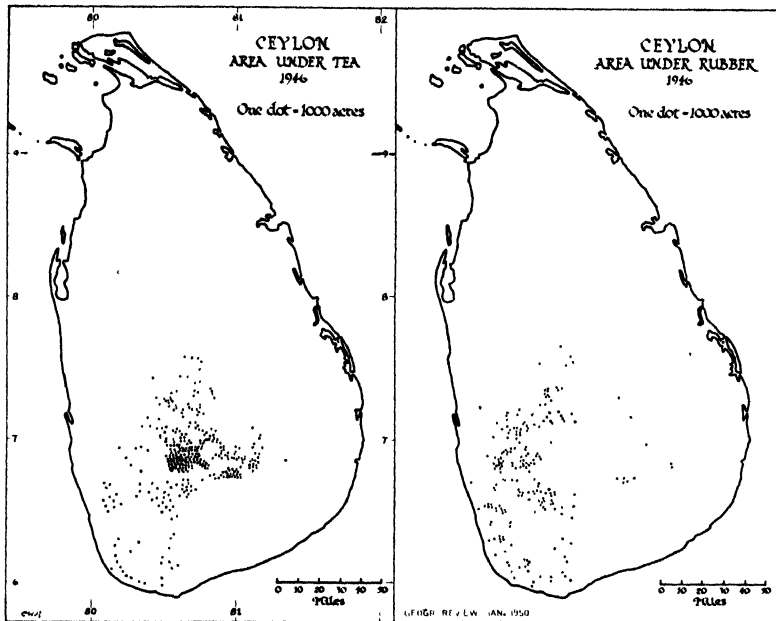


FIG. 18

FIG. 19

are to be found, and the best tea is grown, in well-watered highlands above 3000 feet.

Peasant cultivation is significant in the densely settled areas just west of Kandy and, increasingly it seems, in the hills behind Galle and Matara. On the whole, however, the total tea acreage tends to remain stationary or even to decrease slightly. In addition to such difficulties as soil erosion, not much new land suitable for tea remains; and, in any case, there have been restrictions on new planting as a result of the international controls established in the 1930's. Labor costs, too, are increasing.

Rubber. Of the 573,243 acres under rubber in 1946, 340,714 acres, or about 60 per cent, were in "A" estates. In general, rubber clings to the westward-facing slopes of the south-central highlands (Fig. 19, which shows total area under rubber), but at lower altitudes than tea; in places it even descends to sea level. It also extends into the Matale District, northeast of Kandy, and into the coastal hills behind Galle and Matara. There are even isolated planta-

tions on the extreme eastern edge of the wet zone, toward the Bintenne. Only in relatively small areas is there strict monoculture of rubber. On the southwestern lowlands and slopes it interdigitates with paddy, coconuts, and other crops, and at Matale and elsewhere with tea. Peasant cultivation is seen in the southwest, behind Galle and Matara, and between Colombo and Ratnapura.

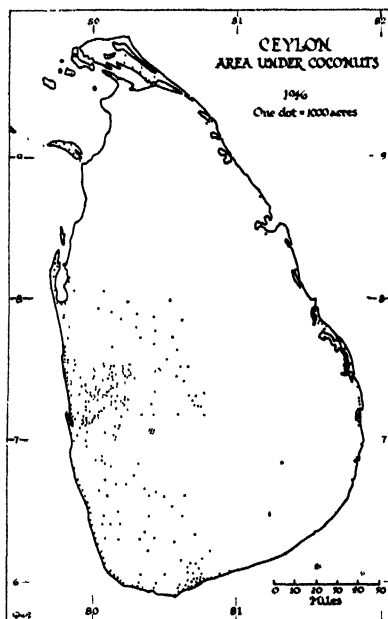


FIG. 20

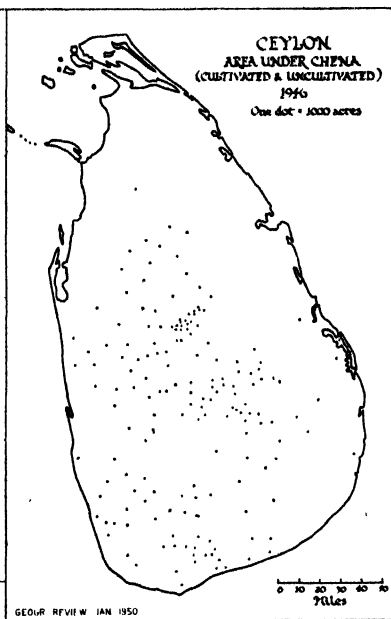


FIG. 21

The future of rubber is uncertain. There is more room for new plantations of rubber than of tea, but, aside from government control of planting, current low prices, due partly to the competition of synthetic products,²² are uneconomic. Labor costs are mounting, and the trees are suffering from the "slaughter tapping" practiced when, after the Japanese occupation of Malaya, Ceylon supplied 90 per cent of the Allies' natural rubber. Many estates really need replanting.

Coconuts. In 1946 there were 920,093 acres under coconuts in Ceylon, of which 107,437 acres, or only about 12 per cent, were in "A" estates. Even the figure of almost a million acres would seem to be an underestimate.²³ For, in addition to the continuous areas of coconut recorded by the census, a host

²² Ceylon, like Malaya, complains of the United States policy of maintaining a high level of synthetic-rubber production.

²³ See R. Child: Ceylon's Coconut Crops, *Tropical Agriculturist*, Vol. 92, 1939, pp. 330-335.

of trees grow in twos and threes in the compounds of huts and in the untidy-looking mixed gardens that defy the enumerator but perhaps accord better with ecological principles than the clean-weeded estates beloved by the European. In many parts of the country the coconut is inseparable from the Sinhalese way of life. Important as its products are in the export trade, it is essential to the peasant, providing him with food, drink, shelter, and many other things.

Although incomplete, the map (Fig. 20) does give some idea of the main coconut areas. The coconut is grown on most inhabited parts of the coast, especially where the soils are sandy. The greatest coastal concentrations are north of Colombo. In the Jaffna Peninsula and the near-by islands and south of Batticaloa the acreages are smaller, perhaps, than might be expected. But the coconut spreads far inland behind the Colombo-Puttalam coast and behind Matara, interdigitating with paddy and rubber and reaching considerable altitudes. It is characteristically rare in the interior of the dry zone.

There are physical possibilities of extension, for example on the east coast, and coconuts will no doubt follow peasant colonizers into suitable areas. Commercially, in spite of the current shortages of oils and fats, the outlook is darker, partly because of past depressions, which have left Sinhalese owners short of capital and with their estates mortgaged to Indian moneylenders, partly because of the increasing age and decreasing yield of the trees. Replanting today would be costly, even if capital were available.

Tea, rubber, and coconuts make up some 90 per cent of Ceylon's exports, and this fact is a measure of their continuing importance. Of other estate products the 1946 census gives no details. A certain amount of cacao is grown in the Kandy and Matale areas, but coffee has entirely disappeared since the fungus disease attacked it.²⁴ There are small acreages under cinnamon, cardamoms, and other spices for which Ceylon is traditionally famous.

Only about 1.4 per cent of the paddy land on the island was included in the "A" estates in 1946. In spite of occasional optimistic opinions,²⁵ capital has never been attracted to the large-scale cultivation of paddy. Prices have till very recently been kept down by cheap imports from Burma; under the relatively inefficient local methods, profits have never justified investment. Paddy remains a peasant crop.

²⁴ See E. C. Large: *The Advance of the Fungi*, London, 1940.

²⁵ For example, by E. Elliott: *Rice Cultivation under Irrigation in Ceylon*, *Journ. Ceylon Branch Royal Asiatic Soc.*, Vol. 9, 1885, pp. 160-170. Elliott thought that, given irrigation and suitable agricultural methods, paddy cultivation was a commercial proposition.

PEASANT CROPS: PADDY

Of the peasant cultivator's usual holding of "high land" and paddy land, as a rule only the latter lends itself to full enumeration in terms of area. Most of the paragraphs that follow are concerned with paddy or its dry-zone substitutes. But the importance of coconut land and garden land must not

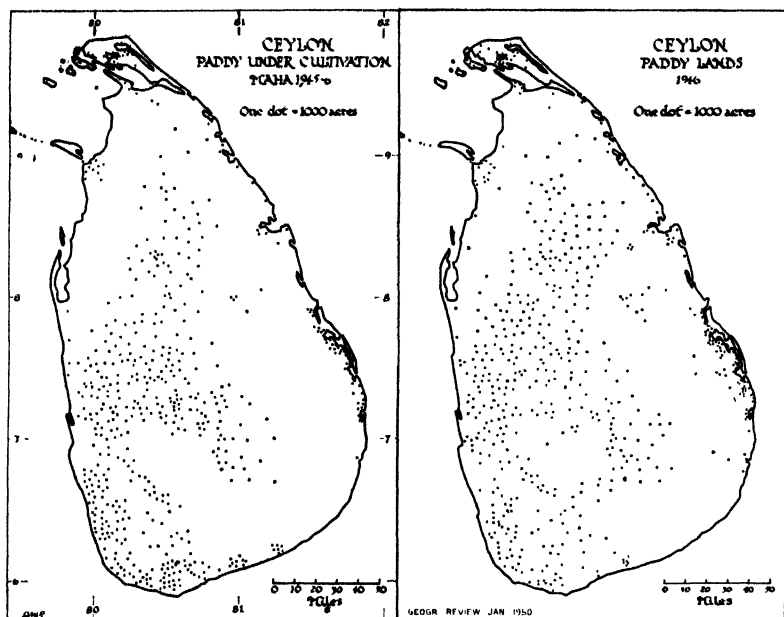


FIG. 22

FIG. 23

be overlooked; it is usually easier to find them than good potential paddy land.

In 1946, 912,500 acres of Ceylon consisted of paddy land (Fig. 23). In the wet zone a belt runs parallel to the coast but a little inland—leaving the shore itself to the coconut and to village gardens—and sends tongues up the principal river valleys. This belt, with its tongues, is mainly related to flood-plain cultivation. A second group of paddy lands climbs the hills to the Kandy region, and here flood-plain cultivation is combined with ingenious terracing. This group passes into a third, scattered among the valleys of the Uva Basin and the middle Mahaweli Ganga. In the dry zone there are two superimposed patterns, one of fairly large and compact areas, the other of small scattered ones. The first may be readily related to major irrigation works, the second to minor tanks and to the wells of Jaffna.

There are two main seasons for paddy cultivation, the *maha*, or great season, during the northeast monsoon, and the *yala*, or little season, during

the southwest monsoon. In any year some fields are cultivated for maha paddy, some for both maha and yala, and some are not cultivated at all. Figure 22 shows the distribution of the 620,683 acres, or about 69 per cent of the total, cultivated for maha, 1945-1946. Much more use was made of the wet-zone paddy land than of that in the dry zone, in spite of the fact that maha corresponds to the dry-zone wet season. It is perhaps a little unfair to generalize from this one year, particularly since no census figures are available for the corresponding yala; but it is usually true that the wet-zone peasant uses his land far more intensively than his brother in the dry zone. His tiny holding is often made to yield two crops a year. On the whole, however, his agricultural methods do not stand comparison with those of the rice cultivators of China or of Japan, for instance. Not enough manure is used. The Department of Agriculture has found it difficult to persuade peasants to accept bone meal free of charge, because of the condition that the peasant himself apply green or organic manure.²⁶ Cultivation is often poor, owing partly to the shortage and low quality of draft animals. Seed, mainly of inferior type, is usually sown broadcast, and nursery beds and transplanting are rarely used. Many things are to blame for this state of affairs. Among the more tangible may be mentioned the tenancy system, under which half of the yield, and therefore half of any increase due to better methods, goes to the landlord; rural indebtedness of the familiar Oriental kind; the subdivision of holdings resulting from the inheritance laws; and the low price of paddy, at least until recently. But there are also many intangible, psychological, reasons. The poverty of the peasant and his backward practices are linked in a vicious circle it is hard to break. Now that separate Research Institutes have been founded for each of the main estate crops,²⁷ the Department of Agriculture is able to devote all its energies to the peasant, notably by propaganda and demonstration. The marketing problem is also being tackled by the encouragement of cooperative methods.

In the region just west of Kandy, which has already been singled out for special mention because of its terraced fields, intensive land use, and peasant tea cultivation, pressure on the land is great, but far better practices are in use than are the rule in Ceylon.²⁸ The maha is grown by transplanting; manuring and composting are practiced; and some cultivators are using a moldboard plow (Fig. 25) and a harrow. This is, one hopes, an earnest of what may ultimately be achieved in other parts of the wet zone.

²⁶ See the *Administration Report of the Acting Director of Agriculture for 1940*, Colombo, 1941, p. 14.

²⁷ See the *Administration Report of the Acting Director of Agriculture for 1939*, Colombo, 1940, p. 3.

²⁸ W. Molegoda: Paddy Cultivation in Kandy, *Tropical Agriculturist*, Vol. 99, 1943, pp. 152-156.

In the dry zone, in many places, physical conditions as well as backward techniques militate against good farming. Minor irrigation works often fail, and sometimes major ones, and rainfall is variable. Malaria is endemic. The cultivator has some additional failings; in particular, he tends to waste water and land.²⁹ In general, the excellent major irrigation works are designed to supplement rainfall for maha cultivation and occasionally to permit yala. The peasant is meant to sow his crop at the beginning of the wet season and use the rains for most of the processes of cultivation, calling on tank water only toward the end. But in many places he tends to cultivate his paddy late, having devoted his attention to chena crops (i.e. grown under shifting cultivation) during the rains, and to use his tank water for almost all the cultivation. This uses three times as much irrigation water and virtually becomes yala cultivation. In general, too, use of the land is more wasteful and erratic than in the wet zone. To cultivate both maha and yala would mean trouble with fertility as well as with water supply, but there seems no reason for the choice of cultivation seasons by some peasants. There is ample scope here for propaganda and demonstration.

As in the wet zone, there are bright spots. For example, the colony watered from Minneriya Tank has been rearranged to permit contour plowing with modern implements, and so far yields have been consistently high—40 bushels an acre in 1946, with good sowings of both maha and yala. There is also some good cultivation in the zone of somewhat older settlement south of Anuradhapura. And little that has been said applies to the Jaffna Tamil, who grows a variety of crops with great industry.

THE PROBLEM OF CHENA

The problem of land use in the dry zone is bound up with the problem of chena. It has been pointed out elsewhere³⁰ that Ceylonese shifting cultivation is unique, particularly because it is practiced by people who are well aware of sedentary methods of cultivation and who possess draft animals. There were, according to the 1946 census, 221,395 acres of chena, of which 46,322 acres were under cultivation in 1946. Figure 21 shows all chena, cultivated and uncultivated, as a measure of the extent of the practice. The figures on which it is based are a little suspect, since it is probable that enumerators overlooked remote jungle clearings, in spite of—or perhaps because of—the fact that

²⁹ See the *Administration Report of the Director of Irrigation for 1939*, Colombo, 1940, pp. 3-4.

³⁰ Editorial, *Tropical Agriculturist*, Vol. 104, 1948, pp. 1-2. See also A. W. R. Joachim and S. Kandiah: *The Effects of Shifting (Chena) Cultivation and Subsequent Regeneration of Vegetation on Soil Composition and Structure*, *ibid.*, pp. 3-11.



FIG. 24—Paddy cultivation in the wet zone of Ceylon showing the traditional method of plowing with buffaloes and wooden plows. Beyond the paddy fields is the characteristic "high land" under coco-nuts and other garden crops. (Photograph by courtesy of the British Information Services, New York.)

FIG. 25—Types of paddy-field plows. Village wooden plow on the extreme left and the two types of iron plows recommended by the Department of Agriculture at the right. The second plow from the left has a moldboard fitted to the village plow. The popular *yakkala* plow is the fourth plow from the left. (Photograph by courtesy of the British Information Services, New York.)

chena is officially permissible only under government license. Chena clearings are fairly common over most of the dry zone and not uncommon in the southern and western hills of the wet zone. The crops grown include varieties of millet, maize, and hill, or dry, paddy, and the chenas are abandoned after a year or two when weeds, rather than decreasing fertility, make further cultivation too arduous.

In addition to the bad effect chena cultivation has on paddy farmers, there are the usual disadvantages of shifting agriculture anywhere. The chena is clearly one way of using nonirrigable dry-zone land, of which there are much greater reserves than of irrigable or potentially irrigable paddy land; but it is obviously desirable to investigate methods of replacing it with something better. Experiments in rotational farming have been carried out with some success³¹ and seem to indicate that under suitable conditions both food crops and cash crops, such as cotton, can be grown without irrigation on a rotational basis and yield a sufficient return to a family. Land similar to that in Ceylon's dry zone is densely settled in southern India, though admittedly at a low standard of living. Meanwhile, the clearing of new chenas is normally subject to strict control, though during the war restrictions were relaxed as part of the food-production drive and a number of "state" chenas were cleared. These were selected, however, with a view to ultimate permanent cultivation.

COLONIZATION

It is the settled policy of the Ceylon government "to produce locally as much of our staple foods and other requirements as we are able to do with reasonable efficiency."³² Efforts are already being made to achieve more intensive, efficient, and varied cultivation, particularly in the wet zone, and the latest available reports³³ show that there is steady progress. But even if existing wet-zone agricultural land could feed Ceylon at present standards of living, it is most unlikely that it could take care of the future, to say nothing of raising the standard of living. It is not easy to forecast the future population of Ceylon, but it is estimated³⁴ that the 6½ million of 1946 will have grown to 8 million by 1971 if present trends continue. It is not surprising, therefore, that the Ceylon government has stimulated by all means at its disposal the colonization of previously unoccupied land, though the spectacular nature of

³¹ P. T. Jinendradasa: Rotational Farming Scheme, Kurundankulama, *Tropical Agriculturist*, Vol. 104, 1948, pp. 27-37.

³² See "Post-war Development Proposals," Colombo, 1946, p. 37.

³³ For example, the *Administration Report of the Director of Agriculture for 1947*, Colombo, 1949.

³⁴ See "Post-war Development Proposals," p. 1.

some of its projects must not blind us to the sober but significant intensification of agriculture in existing farmlands.

The assault on the wastelands of Ceylon is no new phenomenon. The establishment of estates in the nineteenth century took agriculture into many new areas, and the gradual restoration of ancient irrigation works under colonial rule attracted some peasant settlement into the dry zone; a few peasants drifted north and east from the wet zone on their own initiative. What is new, however, about the assault since 1935 is the scale on which all the resources of the state have been thrown into the battle, which has been waged on several fronts at once. The peasant, moreover, and not the estate owner and his coolies, has been the main participant.

The administrative framework for this newly vigorous assault is provided by two Ceylon government ordinances, the Land Settlement Ordinance of 1931 and the Land Development Ordinance of 1935. The former³⁵ concerns settlement in a legal sense, namely the establishment of title to land and, in particular, the establishment of the boundaries of crown land that the government seeks to alienate to colonists. The work of survey and negotiation is still going on. The Land Development Ordinance,³⁶ on the other hand, concerns the reservation of crown land for specific purposes, particularly for village expansion, chena, and colonization, but also for a number of other purposes of interest to the geographer; for example, the protection of the sources of streams and the prevention of soil erosion. Gradually, all available crown land is being mapped out for one or another of these purposes.

The Land Development Ordinance provides that land may be alienated by grant to a man and his successors in perpetuity, with safeguards to prevent undue subdivision of the holding on the death of the holder, or by permit, personal to the holder only. A small annual charge is payable in each case, but it may be waived. Attached to each grant and permit is a schedule laying down, for example, that the holding, or a specified part of it, shall be regularly cultivated—chena cultivation is not deemed to be regular cultivation—together with other conditions of cultivation and conservation. It will be seen that the Ceylon government hopes to avoid in its colonization schemes not only the evils and malpractices that have become associated with agriculture in the country's areas of older settlement but also those that unfortunately accompanied the white settlement of new continents.

In practice, the assault on the waste in Ceylon has taken place on three

³⁵ See the *Administration Report of the Settlement Officer for 1937, 1938 and 1939*, Colombo, 1940, p. 7, for an excellent summary of the nature of settlement work.

³⁶ See the *Administration Reports of the Land Commissioner and of the Director of Irrigation*, Colombo, and the pamphlet "Land for the People." Minister of Agriculture and Lands, Colombo [1948].

main fronts: village expansion, peasant colonization, and alienation to middle-class Ceylonese. Village expansion is, of course, the familiar process by which, for example, medieval villages gradually encroached on the waste between them. In Ceylon there is a steady demand in many areas for land for village expansion, both in the wet zone and in the dry zone, though in the latter, of course, the available land is strictly limited. In necessity the government may purchase private land, for example an estate (or, alternatively, compensate the owner by a grant of land in the dry zone), in order to satisfy a demand for village expansion. Possibly, if the position of the rubber planter remains difficult, more and more rubber estates will become village farmland. In the dry zone, on the other hand, large areas have been reserved for village expansion, 74,000 acres in the Anuradhapura District alone.

Peasant colonization has been greatly accelerated in recent years, and widespread changes have been made in the effort to encourage it. It has become increasingly realized that rapid and successful peasant colonization cannot be achieved, even under the provisions of the Land Development Ordinance, merely by granting land on favorable terms and providing water in the main channel of an irrigation work. Even the sturdy American pioneer of the last century would have been deterred by the problem of jungle clearing and by the hazards of drought and disease, particularly if prevailing prices for his staple crop were fantastically low; and the Ceylon peasant is, largely through no fault of his own, by no means the equivalent of a sturdy American pioneer. Undernourished and diseased, apathetic and ill-instructed, he needs more than land and water to attract him away from his friendly, if overcrowded, wet-zone village, particularly if the land bears four hundred large trees to the acre, and if the water lies some distance away in a main channel from which he himself must lead it. And if the peasant is not attracted, capital lies idle and irrigation water runs to waste.

In the interesting report on the Minipe Yoda 'Ela scheme, published in 1940,³⁷ it was merely recommended that free tools should be provided, and that colonists should then receive assistance in the task of clearing their holdings. Even this was an advance on older, laissez-faire methods. By 1942, however, the Irrigation Department had taken up land-development work,³⁸ the decision having been made that a colony should be fully opened up before colonists were brought in. The Department assumed responsibility, at Minipe and in other schemes, for the "conversion of the jungle into ready-made farms." It planned to clear the jungle, to clear, burn, reclear, stump, ridge,

³⁷ "Report on the Minipe Yoda-ela Scheme," *Ceylon Sessional Papers*, VI of 1940. See also Figure 4.

³⁸ See the *Administration Report of the Director of Irrigation for 1943*, Colombo, 1945, especially pp. 5 and 12.

plow, and harrow the land, and to build brick houses before the colonist appeared. At Minipe such work went on during the war years under great difficulties;³⁹ health was not good, and labor and mechanical equipment were short. Nevertheless, in 1943 an average of 550 men were at work and from April on were actually fed on paddy grown on the scheme during the previous maha. In 1944, Italian prisoner-of-war labor was brought in, and by 1946, 212 houses had been built and 361 farms, totaling 1805 acres, had been prepared. Late in 1946 the Irrigation Department handed over, at Minipe and elsewhere, to the Land Commissioner, since, in the words of the Director of Irrigation, land development had "assumed such proportions [that] it is interfering with the legitimate work of the Department."⁴⁰ For by that time preparation for colonies included, in addition to the tasks already mentioned, road building and the construction of hospitals and meeting halls. Other government departments were responsible for malaria control, for the fostering of cooperative societies for marketing, for loans to peasants on easy terms, and so on, so that, to quote the Director of Irrigation again:

All [is] very different from twenty years ago, when the pioneers moved into virgin forests uninhabited except for the Irrigation Engineer and his men, and had to fell the forests, build themselves huts, and fight what generally proved to be a losing battle with fever and wild animals from the jungle surrounding them. Nowadays the colonist is definitely better off than his brothers in the urban areas.⁴¹

By the end of 1947, there were estimated to be 2900 families living on 21,000 acres of land in the main colonies of Minneriya, Minipe, Tabbowa, Kagama (near Anuradhapura), Karachchi-Iranamaduru, Parakrama Samudra, Elahera, Ridi Bendi Ela, and Beragama. These comprise, for the most part, holdings of irrigated paddy land, with a proportion of high land.⁴² There is also an important scheme of a different type in Pasdun Korale East, the region of strike valleys and ridges in the wet zone between Ratnapura and the coast. Here are scattered colonists, some making new rubber plantations on steep slopes, with compulsory soil conservation.⁴³ Further schemes are in various stages of development, and it is hoped that by 1953 some 5900 peasant families will be settled on the land. The demand for holdings is now undoubtedly keener.

Middle-class Ceylonese colonization has been smaller in scope and in

³⁹ See the Administration Reports of the Director of Irrigation for 1943 (Colombo, 1945), 1944 (Colombo, 1946), and 1946 (Colombo, 1947).

⁴⁰ See the *Administration Report of the Director of Irrigation for 1946*, Colombo, 1947, p. 9.

⁴¹ *Ibid.*, p. 10.

⁴² See "Land for the People" (*op. cit.*). For major irrigation works on which colonies are based see Figure 4.

⁴³ See the *Administration Report of the Land Commissioner for 1939*, Colombo, 1940.

many ways less successful. At Minneriya in 1937, for example, a number of grants had been made to middle-class Ceylonese, but many of the holdings remained uncultivated and had to be reallocated to peasants.⁴⁴ Elsewhere the "colonists" have become absentee landlords. It cannot yet be said that in general the scheme has achieved its objective of attracting educated young men away from urban white-collar jobs and turning them into real farmers, able and willing to play their full part in a revived rural society in the dry zone.

Aside from village expansion and peasant and middle-class colonization, the Ceylon government, through its Department of Agriculture, has launched its own direct assault on the waste. Various kinds of state and departmental farms have been set up. There are a number of such farms, together with experimental stations, in the dry zone, growing mainly high-land crops, often of an experimental nature (for example, sugar cane at Hingurakgoda in the Minneriya colony). Others have tried out mechanical methods of cultivation that may eventually do much to increase productivity. Further state farms are intended to foster stock raising and milk production, inevitably under difficulties in a mainly Buddhist country. One such cattle farm, at Polonnaruwa, covers 6800 acres, of which 400 acres are under improved pasture and 3100 acres under permanent natural pasture. Others, at Ambawela and Bopatalawa, seek to exploit the patanas of the Nuwara Eliya District, replacing some natural grasses with fodder grasses.⁴⁵

A small amount of dry-zone land also continues to be sold or leased under regulations older than the Land Development Ordinance of 1935; and there is always illicit cultivation of chenas to reinforce the official assault on the waste.⁴⁶

But all this is clearly only a beginning. Fifty-nine hundred families make up but a small fraction of the total population of Ceylon, and not a very large fraction of the decennial increase; and not all colonists will stay on their farms. The cost of irrigation works and colony preparation is very high,⁴⁷ and there are many problems to be solved before the capital thus invested bears full dividends, not least the problems of attracting the right types of settler, in the right proportions to achieve balanced societies, and of improving their agricultural methods by example and demonstration.

⁴⁴ See the *Administration Reports of the Land Commissioner for 1937* (Colombo, 1938), pp. 7-8, and for 1938 (Colombo, 1939), p. 9; and the *Administration Report of the Director of Irrigation for 1943*, Colombo, 1944, pp. 3-4.

⁴⁵ See the *Administration Report of the Director of Agriculture for 1947*, Colombo, 1949, for full details of state and departmental farms.

⁴⁶ See the *Administration Report of the Government Agent for the North-Central Province for 1939*, Colombo, 1940, p. 5.

⁴⁷ See Jennings, *The Economy of Ceylon* (*op. cit.*), p. 12.

RECENT INDUSTRIAL DEVELOPMENT IN THE GULF SOUTH

JAMES J. PARSONS

THE physical growth of America's industrial plant in the past decade has perhaps nowhere been more spectacular than in the Gulf South. Unsurpassed accessibility to petroleum, natural gas, and key chemical raw materials is here combined with low power costs, tidewater shipping facilities, a mild climate, and a growing regional and export market. Each of these factors, together with a boundless enthusiasm for regional promotion, has contributed to a proliferation of industrial plants on the coastal plains and in the piny woods that is remolding the face of the landscape in much of Texas and Louisiana.

Unlike the Pacific Coast States, where also industrial expansion has been greatly accelerated in recent years, neither Texas nor Louisiana has received any mass influx of population. In fact, between 1940 and 1947, the period of maximum population displacement in the United States, there was an estimated net out-migration of 140,000 persons from Texas and 119,000 from Louisiana.¹ The total population of the two states, estimated by the Bureau of the Census at 9,806,000 in 1948, has increased 22 per cent since 1930, a rate only 3 per cent above that for the nation and one that is due wholly to natural increase.

EXTENT AND CHARACTER OF INDUSTRIAL GROWTH

The bulk of the manufacturing employment is concentrated in a few metropolitan areas. More than half of Texas' 242,000 production workers reported in the 1947 Census of Manufactures were in four of the 254 counties: Harris (Houston), Dallas, Tarrant (Fort Worth), and Jefferson (Beaumont-Port Arthur). In Louisiana, where 50,000 of the 110,000 wage earners were in the New Orleans Metropolitan District and East Baton Rouge Parish, the concentration is partly camouflaged by the highly dispersed lumbering and pulp and paper industries, which together accounted for more than one-third of the state total.

¹ "Estimates of the Population of the United States, by Regions, Divisions, and States: July 1, 1940 to 1947," *Current Population Repts.: Population Estimates*, Ser. P-25, No. 12, U. S. Bureau of the Census, Aug. 9, 1948.

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Here, as elsewhere, the rural farm population, in part displaced by the increased mechanization of agriculture, has been drawn in large numbers to the urban centers. There are few cities in the Gulf South that cannot boast a doubled population in the past 30 years or less. Oil-rich Houston, bellwether of the Gulf Coast cities and leading industrial metropolis of the South, has witnessed a metropolitan (Harris County) population growth from 63,000 in 1900 to an estimated 780,000 in 1949. The city is the center of the oil and gas industry and one of the most important deep-water ports in the country. In tangible form its growth is evidenced by modern skyscrapers, endless new bungalow subdivisions, factories and warehouses along the Ship Channel and the five trunk-line railroads that radiate from the center of the city. Unlike most older cities, Houston has not piled up a "vertical population." Both in its sprawling physical structure and in its ebullient confidence in its own destiny it resembles Los Angeles more than any other city in the country.

In contrast, New Orleans (estimated metropolitan district population 666,000) and Dallas (estimated Dallas County population 545,000) are financial and wholesaling centers, where industrial expansion has been largely confined to the food, apparel, and other consumers' goods industries.

Between 1929 and 1947, comparable years of capacity peacetime production, factory jobs in Texas and Louisiana increased 60 per cent. Yet neither state qualifies even remotely as "industrialized," their combined wage-earner density (percentage of the total population engaged in manufacturing) being 3.3 per cent in 1947, as compared with 7.9 per cent for the nation. Together they contained an estimated 6.7 per cent of the total population yet accounted for only 2.7 per cent of the nation's factory pay roll (in dollars), 3.0 per cent of its production workers, and 3.2 per cent of all "value added by manufacture." Although gains have been registered in each of these categories, the economy is still exploitative, based primarily on oil and cotton.

Nevertheless, the recent growth of the physical industrial plant in Texas and Louisiana has been impressive. The vast facilities built to meet wartime emergencies have nearly all been converted to peacetime production, and private capital has financed a huge postwar building program. The petroleum refining and chemical industries, with their peculiarly high ratio of capital investment to labor force, can probably be credited with more than 90 per cent of all new development. The chemical industry, in particular, has experienced a striking growth: the number of production workers in Texas and Louisiana rose from 10,700 in 1939 to 27,400 in 1947. Capital has come in equal measure from the government (especially for synthetic rubber) and

from established eastern concerns, several of which have concentrated a large part of their postwar expansion along the Gulf Coast. Labor has been supplied almost entirely from the local market at wage rates prevailing in the Northeast, but modern technological advances, especially automatic instrument control, have meant relatively few jobs in relation to investment. The largest

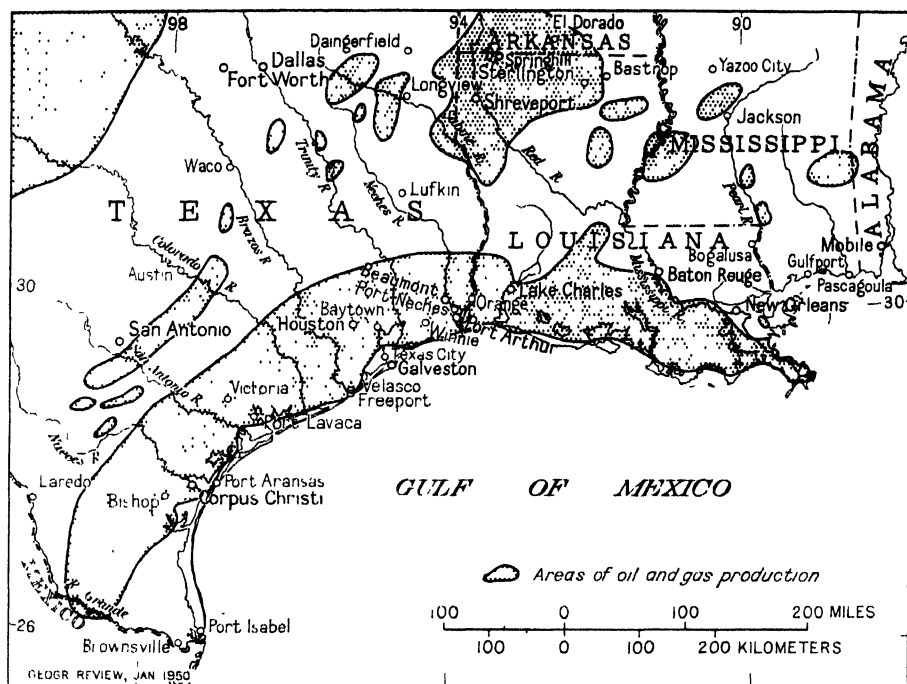


FIG. 1—The Gulf South, showing generalized areas of oil and gas production.

chemical plant in the region, Dow's twin installation at the mouth of the Brazos River in Texas, is manned by only 3 100 employees, though it represents an investment of more than 165 million dollars.

Virtually all the new plants are removed from existing built-up areas, where land has been cheap, taxes lower, and waste disposal problems at the minimum. The grimy, congested factory district of the older manufacturing centers is not a part of the industrial landscape developing on the Gulf Coast. Larger plants commonly stand in the center of vast tracts of company-owned land. In some places, such as Lake Charles, La., and Borger, Tex., much of the working population lives in new model communities, usually government-built and often several miles from the parent city. The population within a 15-mile radius of Borger, a synthetic rubber, carbon black, and petroleum refining center in the Texas Panhandle, has increased since 1940

from 15,000 to an estimated 45,000. The growth of the Freeport-Velasco area, site of the Dow Chemical Company, has been fully as spectacular.

The extreme sensitivity of the chemical industry to availability of raw materials accounts for the larger part of the industrial development, especially in the Gulf port cities. Synthetic organics, made from ethylene, propylene, and butylene derived from petroleum and natural gas, are the most important group of chemicals produced. Seventy-five chemical companies are said to have built plants on the Gulf Coast since 1940, half of them since the end of the war. Investment in chemical plant facilities here between 1940 and 1947 represented 26 per cent of the national investment in such facilities,² in a period when the chemical industry was nearly doubling its productive capacity.

Government financing of war plants between 1939 and 1945 in the West South Central States (Louisiana, Texas, Oklahoma, and Arkansas) was nearly five times their share of "value added" in 1939.³ Texas led all the states in the dollar value of industrial construction contracts awarded in both 1946 and 1947, according to trade estimates. In 1948, although ranking second to California, it contributed 12.8 per cent to the country's industrial building.⁴

PORT DEVELOPMENT

Development of deep-water shipping facilities was a necessary preliminary to much of the Gulf-Coast's new industrial activity. Outshipments of wheat, cotton, crude oil, refinery products, sulphur, and phosphate rock still constitute the main part of the Gulf ports' commerce, but manufactured products are moving increasingly to both foreign and eastern markets. Completion of the 80-million-dollar, 1100-mile Intracoastal Waterway in

² *Chemical and Engineering News*, Vol. 25, 1947, p. 79.

³ A. J. Wright: Recent Changes in the Concentration of Manufacturing, *Annals Assn. of Amer. Geogrs.*, Vol. 35, 1945, pp. 144-166; reference on p. 161.

⁴ An analysis of industrial construction contracts announced in the *Engineering News-Record* from July, 1945, through December, 1948 (released in processed form by the Territorial Information Department, 140 South Dearborn St., Chicago, Ill.), shows a total investment of 323 million dollars in Texas, as compared with 191 million in California, 169 million in Ohio, 147 million in Pennsylvania, and 118 million in Illinois. Among leading industrial areas, Houston ranks first with 110 million dollars of new projects, as compared with New York-Newark-Jersey City, 88 million; Pittsburgh, 79; Chicago, 79; Detroit, 76; Cleveland, 75; Philadelphia-Camden, 56; Los Angeles, 55; and San Francisco-Oakland, 48. Omitted from these calculations are contracts valued at less than \$100,000 and those carried out by the industrial concern itself.

For chemical plants alone, for the longer period 1939-1947, combined government and private investment (in millions of dollars) within the Gulf South was distributed as follows: Sabine-Neches industrial area, 166; Freeport-Velasco, 163; Houston, 144; Baton Rouge, 113; Lake Charles, 49; Borger, 49; Corpus Christi, 45. Magnesium facilities are included in these figures (computed from a list of plants in *Chemical Industries*, Vol. 60, 1947, pp. 404-406, and other sources).

mid-1949 has given Brownsville and the lower Rio Grande Valley a direct barge link with the Mississippi River system. Feeder canals connect to eleven inland Texas towns in addition to those served by the six deep waterways between the Mississippi and the Rio Grande: Calcasieu (Lake Charles), Sabine-Neches (Port Arthur, Beaumont, Orange), Galveston-Texas City-Houston, Freeport, Port Aransas-Corpus Christi, and Brazos Island (Port Isabel-Brownsville). Dallas and Fort Worth, 300 miles inland, expect to be linked eventually to the Intracoastal by canalization of the Trinity River, as does Shreveport on the Red River.

As American industry increasingly reaches across the seas for its raw materials,⁵ the Gulf ports should be in a more and more favorable position to supply the westward-moving American market. In the past, imports have been significant only at New Orleans and Mobile, but recently coffee, jute, newsprint, and bananas have been moving into Houston in growing quantities. South American ores and petroleum may one day become major imports here, depending in part on the long-term policy for conservation of domestic resources adopted by industry and government.

The new stature of the Gulf ports is indicated by the fact that in a recent year eight of them—Houston, New Orleans, Beaumont, Port Arthur, Texas City, Port Aransas, Lake Charles, and Corpus Christi—were among the country's fourteen leading deep-water ports in tonnage. Except for Houston and New Orleans, petroleum products, destined primarily for domestic markets, constituted all but an insignificant part of the total. In 1948 the Gulf ports handled between 20 and 25 per cent of the water-borne foreign commerce of the country, measured either by value or by weight, and a considerably larger percentage of shipments on Army and Navy chartered vessels. New Orleans still ranks an easy first among them in foreign trade, with Houston and Galveston competing for second place and Mobile fourth.

Everywhere in the Gulf South port development has depended more on community push and drive than on natural advantages. Texas alone has 13 deep-water ports that are largely man-made, the most important of which owe their existence to the Houston Ship Channel and the Sabine-Neches Waterway. The former is a 58-mile-long artificial channel, 34 feet deep, which links Houston with Galveston Bay and the Gulf of Mexico. Regular sailings from the Port of Houston began in 1915, with the completion of the dredging of Buffalo Bayou. In 1948 the port handled more than 40 million tons (of which 5½ million was foreign trade), a new Gulf port record. It has

⁵ Jean Gottmann: *Changements de structure dans la géographie humaine des États-Unis*, *Annales de Géogr.*, Vol. 57, 1948, pp. 131-145 and 219-226.

remained basically a raw-materials port, with more than 80 per cent of its cargo petroleum products and much of the rest cotton. Galveston, a "dry cargo" port, ships principally cotton, wheat, and sulphur. Since the destruction of the Texas City port facilities in 1947, considerable Bolivian tin concentrate has moved across Galveston's wharves.

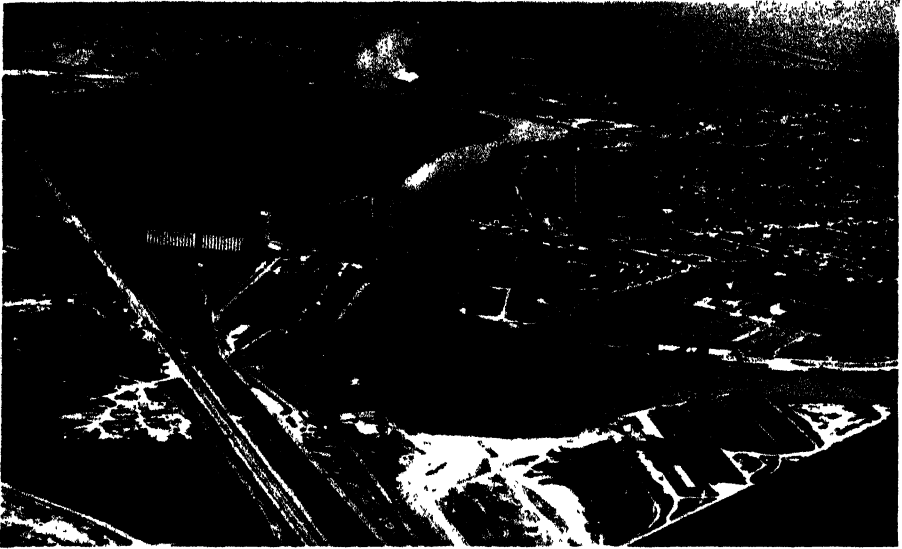


FIG. 2.—Turning basin of the Houston Ship Channel, looking east. The channel is lined with industrial plants for much of the 26 miles from the turning basin to Galveston Bay. (Courtesy of the Houston Port and Traffic Bureau.)

The Sabine-Neches Waterway links Beaumont, Orange, Port Arthur, and Port Neches to the Gulf by 61 miles of channel dredged into the soft organic muck of the coastal plain. Collectively the Sabine-Neches ports outrank Houston in tonnage handled, owing chiefly to heavy shipments of petroleum products. At Port Arthur, one of the Gulf Coast's youngest, most rapidly growing, and most interesting cities, two of the largest oil refineries in the country stand side by side, employing 11,000 persons and drawing oil by pipe line from East and West Texas, Oklahoma, Kansas, and Louisiana.⁶

An aggressive campaign to win the interior trade once securely in the hands of eastern ports has permitted New Orleans to challenge Baltimore for the title of "America's Second Port" in terms of value of cargo handled, in the same way that Houston has moved into contention for second place on the basis of tonnage. Baton Rouge, 220 miles from the mouth of the Missis-

⁶ J. W. Newton: The Sabine-Neches Area of Texas: An Industrial Survey, *Texas Geogr. Mag.*, Vol. 13, 1949, pp. 5-10.

issippi, at the head of navigation for ocean-going vessels, ships the bulk of the petroleum products from its great refinery upstream by barge to the interior of the continent. Bauxite from the Guianas is imported for the new Kaiser alumina plant. Bauxite also moves in significant quantities to Mobile, where an Aluminum Company of America plant has been operating since 1939, and to Gulfport, Miss., a government stock-piling depot.

PETROLEUM

Petroleum and natural gas are the basis for the Gulf Coast's rapid urban and industrial growth. Since the Spindletop field came in south of Beaumont in 1901, crude-oil production in Texas alone has amounted to one-third of the all-time production of the United States and 21 per cent of world production. In 1947, Texas produced 44 per cent of the country's crude oil and contained 55 per cent of its proved reserves. Louisiana and Mississippi, with 10 per cent of the reserves, have become major producing states. Since 1941, Louisiana's new coastal fields have pushed it ahead of Oklahoma and Illinois to rank third, behind Texas and California.

Although changing standards of recovery and conservation, together with new developments offshore on the so-called "tidelands," have raised proved Gulf Coast petroleum reserves to new highs, the area is nonetheless living on accumulated capital rather than on the interest of its natural wealth. Vastly increased domestic requirements for crude petroleum (now close to six million barrels a day) will hasten the time when resort must be had to import, shale, or synthetic sources. Soaring exploration and recovery costs may even price Gulf Coast oil out of some of its markets long before exhaustion threatens. Recently, for example, comparison of the costs of many synthetic organic chemicals when produced from petroleum and from coal (via acetylene) has become increasingly favorable to coal.⁷ This trend, if continued, may have serious implications for the burgeoning petrochemical industry.

Petroleum refining has tended in recent years to be located nearer to market centers than to producing areas, apparently because markets are more assured and constant than crude-oil supplies.⁸ On the Gulf Coast, however, this tendency has been less pronounced than elsewhere. In 1947 refinery runs in Texas and Louisiana represented 68 per cent of crude-oil production in the two states (as compared with 74 per cent in 1940), in part owing to cheap

⁷ H. W. Zabel: What's Ahead for Petrochemicals? *Chemical Industries*, Vol. 62, 1948, pp. 390-393.

⁸ On this general subject see "Petroleum Transportation," *Industry Rept.: Domestic Transportation*, U. S. Dept. of Commerce, Office of Domestic Commerce, Jan.-Mar., 1949.

water transportation available to domestic markets, in part to the mild winters, which cut refinery construction costs by the elimination of much costly weatherproofing, pipe insulation, and roofing.

Thirty-four per cent of the country's petroleum refining capacity is in Texas and Louisiana (totaling 2,076,950 barrels of crude oil daily). Most of the refineries are clustered in four principal districts: Houston-Texas City (802,000 barrels), Beaumont-Port Arthur (705,000), Baton Rouge (235,000), and Lake Charles (131,000). Corpus Christi (88,000 barrels) and New Orleans (75,000) are secondary centers. Of the twelve largest refineries in the country, six are on the Gulf Coast, including the two largest, at Baton Rouge and at Baytown on the Houston Ship Channel.

This large refining capacity has been a powerful attraction to the segment of the chemical industry concerned with the synthesizing of organic molecules. Formerly wasted refinery gases, together with natural gas, provide the starting point for a vast array of synthetic organic chemicals, which in turn are the building blocks for many industrial alcohols, solvents, plastics, explosives, detergents, synthetic rubbers, and synthetic fibers as well as vital raw materials for 100-octane gasoline.⁹ Indeed, the manufacture of high-octane gasoline is itself a complex chemical operation. The high degree of versatility inherent in synthetic organic chemicals ("synthetic" in the sense that they do not occur in nature but are products of chemical synthesis and conversion) leaves room for much fruitful industrial¹ research. Moreover, isomeric modifications in the paraffin, olefin, and acetylene groups are said to give the aliphatic hydrocarbons of petroleum a wider range of industrial possibilities than the aromatic hydrocarbons of coal tar.¹⁰

NATURAL GAS AS A RAW MATERIAL

The increased industrial use of natural gas, both as an industrial raw material and as a clean, cheap, and convenient fuel, has been of particular significance to the Gulf South.¹¹ There is much confusion regarding reserves, but in B.T.U. (British thermal unit) equivalents natural-gas reserves probably exceed petroleum reserves. It has been authoritatively predicted that "the time will come when the products of natural gas and its contained liquids will be more important than the production of oil" in Texas.¹²

⁹ An exhaustive series of articles by E. H. Johnson on the industrial development of Texas, especially the chemical industry, appeared in the *Texas Business Review* between 1943 and 1945 (Bureau of Business Research, College of Business Administration, University of Texas, Austin).

¹⁰ Gustav Egloff, quoted in the *Texas Business Review*, Vol. 18, No. 12, 1945, p. 12.

¹¹ K. W. Johnson: The Natural Gas Industry of the Southwest and Its Significance to Industrial Development, *Monthly Business Rev.*, Federal Reserve Bank of Dallas, Vol. 34, 1949, pp. 33-41.

¹² E. L. DeGolyer in the *Dallas Morning News*, May 22, 1949.

Within the past 10 years natural gas has become an important source of premium gasoline. At nearly 200 cycling and natural-gasoline plants in Texas and Louisiana condensate or distillate is separated from both casing-head and gas-well gas, and the residue, or dry gas, is compressed and either returned to the reservoir or marketed to pipe lines. Economic considerations have been largely the reason for the effective conservation measures for casing-head gas carried out in recent years. In 1948 the Texas Railroad Commission began imposing disciplinary shutdowns on some Gulf Coast fields where flaring of casing-head gas continued. Some sentiment has even been expressed against the further export of Texas and Louisiana gas by pipe lines to domestic and industrial markets in the North, East, and West. The lower house of the Texas Legislature passed a resolution in the spring of 1949 directing the State Railroad Commission actively to oppose any additional interstate pipe lines that would export gas from Texas, indicating that the state should keep its gas at home as an inducement to industry.

Competitive bidding by pipe-line companies has forced the field price of natural gas from two cents a thousand cubic feet to as much as 10 cents within less than 10 years. The price of butane and propane, in increasing demand as domestic fuels, has also risen enormously. Further, the desire of the oil companies to produce maximum amounts of hydrocarbon fuels from existing crude supplies is making refinery gases, another favorite industrial raw material, less and less available. Only the extremely high rate of obsolescence allowed for in the petrochemical industry has made huge capital outlays justifiable where exhaustion of low-cost raw materials lies within the foreseeable future.

NATURAL GAS AS A FUEL

As a cheap fuel natural gas has attracted a growing smelting and refining industry to the Gulf Coast. The best-known plant is the government-owned Tin Processing Corporation smelter at Texas City, still operated in part by Dutch technical personnel, which handles tin concentrates from Bolivia and, in small amounts, from Southeast Asia. The 1948 output of this, the only major tin smelter in the Western Hemisphere, was 23 per cent of world production (exclusive of the U.S.S.R.).¹³ Natural gas is also used by the electrolytic zinc plant opened in 1942 at Corpus Christi, the zinc smelters at Amarillo and Dumas in the Panhandle, and the antimony smelter at Laredo.

Most significant is the Port Comfort plant of the Aluminum Company of America that is rising from the wastelands across Lavaca Bay from Port Lavaca, Tex. Here alumina delivered by barge from Mobile will be reduced

¹³ *Yearbook Amer. Bur. of Metal Statistics 1948*, New York, 1949, p. 100.

to pig aluminum by electrochemical processes. The electricity will be generated by natural gas from wells under Matagorda Bay, the first peacetime use by Alcoa of power other than water power for aluminum reduction except for a brief period in the earliest days of the industry. The scheduled annual output of 57,000 tons will represent about 9 per cent of the nation's aluminum ingot production.

Glass manufacture, often attracted by cheap gas, has been established significantly only at Wichita Falls and Waco, Tex., and at Shreveport, La. Glass sands for these plants are brought from Arkansas and Missouri.

ALKALIES AND CHLORINE

Earliest developments in the Gulf Coast chemical industry were in alkali and chlorine production.¹⁴ Attracted by an almost unlimited supply of brine from the coastal salt domes, lime from shell deposits, and abundant gas and oil for fuel, the Southern Alkali Corporation completed the pioneer soda ash-caustic soda plant at Corpus Christi in the fall of 1934. By the following year similar plants were in operation at Lake Charles and Baton Rouge. These at first employed the ammonia soda process, but later installations provided for the electrolysis of brine to produce both chlorine and caustic. Greatly increased demand led to expansion of these facilities during the war and postwar years, and new plants were opened at Freeport and Houston. Most recently a government-built magnesium plant has been converted into a second electrolytic caustic soda-chlorine unit at Lake Charles, and the company also leases a unit from the government at Pine Bluff, Ark. Today the Gulf Coast produces one-fifth of the nation's electrolytic caustic soda-chlorine output; the Dow Chemical Company at Freeport-Velasco is the leading producer. Oil refineries, chemical plants, and paper mills provide the largest market for these products. Most of the chlorine produced at the new 14-million-dollar Diamond Alkali plant at Houston is delivered to a single customer, by a 10,300-foot pipe line under the Ship Channel.

SYNTHETIC RUBBER

The war gave the synthetic organic chemicals industry of the Gulf Coast its initial boost with the development, almost overnight, of a giant synthetic-rubber program using natural gas and the lighter fractions from refinery runs as basic raw materials. More than half of the nation's war-built synthetic-rubber capacity is represented by the butadiene, styrene, copolymer (GR-S,

¹⁴ W. H. Shearon, Jr.: Chlorine and Alkali Production in the Southwest, *Chemical and Engineering News*, Vol. 26, 1948, pp. 3474-3475.

i.e. Government Rubber-Styrene), and butyl (GR-I, i.e. Government Rubber-Isobutylene) rubber plants of Texas and Louisiana. Although most of the plants in other sections have shut down, the Gulf Coast plants have continued to operate close to capacity since the war. Synthetic rubber's competitive position with respect to natural rubber appears to be favorable. Consumption of synthetic rubber in the United States in 1948 was 442,000 tons (of which 345,000 tons was GR-S), which was well above the 215,000-ton minimum set by Congress and constituted about 40 per cent of total primary rubber consumption.

Butadiene, the principal raw material of GR-S rubber, is produced at Baton Rouge, Lake Charles, Port Neches, Baytown, and Houston from refinery gases supplied in large volume by new processes in cracking, especially catalytic cracking. The largest of the plants, at Port Neches, uses butane from five near-by refineries, removing the butadiene and returning the residue gas for use as fuel. At the synthetic-rubber center of Borger the butane is derived from natural gas. Adjacent to each of these oil-company-operated butadiene units stand copolymer plants, leased from the government by established rubber companies. At Baton Rouge and Baytown there is also production of butyl rubber for inner tubes, another product of refinery gases. The other raw material for GR-S rubber is styrene, made at Velasco and at Texas City from natural gas obtained from near-by cycling plants. By weight the finished product is one part styrene and three parts butadiene. A considerable part of the surplus postwar styrene output has gone into plastics.

OTHER SYNTHETIC ORGANIC CHEMICALS

The stimulus of war brought other petrochemical industries to the Gulf Coast. Natural gas is the raw material, together with air and water, for the manufacture of anhydrous ammonia for fertilizers at government-built explosives plants now operated by private industry at Lake Charles and Sterlington, La., at El Dorado, Ark., and near Dumas in the Texas Panhandle. These four plants, built during the war, received half of the government's investment in such units to provide the fixed nitrogen required for explosives. Plans for a plant, financed by private capital, in Yazoo City, Miss., were announced in 1949.

The Houston area, with its 27 chemical plants along the banks of the Ship Channel, is heralded by some as the future chemical capital of the world. In addition to alkalies and chlorine, its products include synthetic glycerin, sodium silicate, industrial alcohols, insecticides, plastic resins, sulphuric acid, ammonium sulphate, and ammonium phosphate, the last using Florida phosphate rock.

The industrial boom town of Texas City, some 40 miles to the southeast on Galveston Bay, has seen its population increase from 3500 in 1930 to a swollen 27,000 (1949), although half of its 6000 factory workers live in Galveston and other neighboring communities. Here the Monsanto Chemical Company has completely rebuilt its large styrene plant, destroyed by a port explosion in April, 1947, which resulted in the death of more than 500 persons and property damage of 50 million dollars. The even larger Carbide and Carbon Chemicals plant near by produces a long list of synthetic organics from hydrocarbons supplied in part by Texas City's oil refineries.

Refinery wastes also provide the raw materials for the new 22-million-dollar Jefferson Chemical Company plant at Port Neches, which makes ethylene oxide, ethylene glycol, and other glycols for the manufacture of cellophane, plastics, detergents, and brake fluids. A second major chemical plant announced for Port Neches will employ intermediates obtained from Jefferson, which, like many other Gulf Coast chemical companies, is jointly owned and operated by a national chemical concern and a major oil company.

One of the more spectacular postwar developments in synthetic hydrocarbons is the new Sabine River Works of the Du Pont Ammonia Division near Orange, Tex., for the manufacture of nylon salts, methanol for anti-freeze, and formaldehyde and polythene for plastics. The nylon salts solution is shipped to yarn plants in Delaware, Virginia, and Tennessee. About 60 million cubic feet of natural gas is used daily in the plant, obtained from a huge new gas-processing establishment at Winnie, 40 miles to the southwest, where methanol, formaldehyde, and acetaldehyde are also produced. Du Pont has a second nylon salts plant under construction on a 1700-acre tract at Victoria, Tex., which will also use natural gas.

Ground was broken for the first of Dow's two major Texas plants in 1940 at the mouth of the Brazos River. The primary magnesium extracted from sea water here, together with bromine, probably accounted for more than 75 per cent of world production of this metal in 1948. Chemicals produced in important quantities include caustic soda, chlorine, hydrochloric acid, vinyl chloride for plastics, glycols, chlorinated solvents, and ethylene dibromide, the last used entirely in the manufacture of antiknock leaded gasolines. In locating here the company considered such factors as adaptability of the site to huge sea-water intake pumps (300 million gallons is pumped daily from a depth of 30 feet), waste disposal, and the availability of brine, mud shell, natural gas, transportation facilities, and large amounts of cheap land. To secure future supplies of gas for both power and process uses, the company controls nearly 100,000 acres of oil and gas leases through a subsidiary.

Twenty-eight miles southwest of Corpus Christi, near Bishop, the



FIG. 3 —The Esso Company's Baton Rouge refinery and butadiene plant on the Mississippi River. Extensive new housing development in the background. (Courtesy of the Esso Standard Oil Company.)

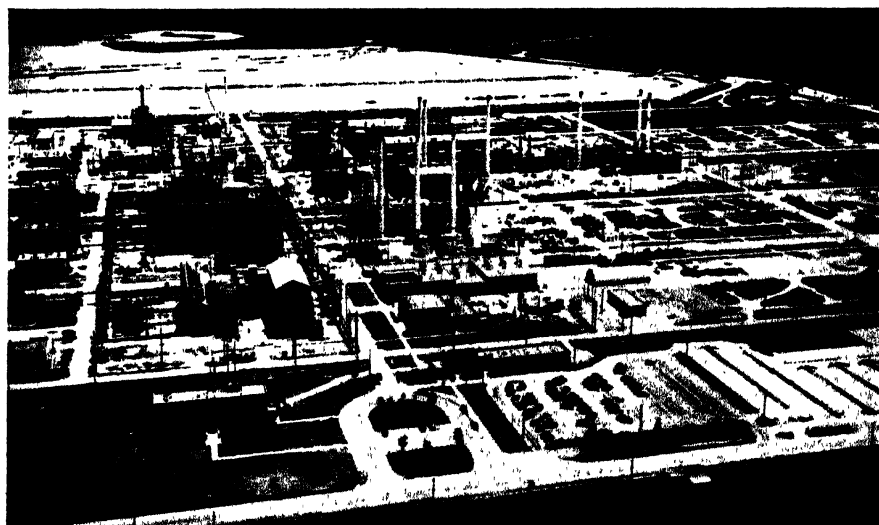


FIG. 4—E. I. du Pont de Nemours and Company's Sabine River works near Orange, Tex. (Courtesy of the Orange Chamber of Commerce.)

Celanese Corporation is using 200,000 gallons of butane and propane a day to produce acetic acid and acetone for its manufacture of cellulose acetate yarn and plastics. Methanol, formaldehyde, and other industrial chemicals are also sold to outside consumers; production both of acetic acid and of formaldehyde at Bishop in 1947 exceeded production for the entire country in 1939. The plant ships 350 to 400 tank cars of organic chemicals a month. In addition to butane and propane, the company uses some 40 million cubic feet of dry natural gas daily for driving compressors. The plant was originally designed for butadiene production, but the war ended before it got into operation. It stands surrounded by fields of grain sorghum in the midst of some of the world's largest natural-gas reserves. On the south it is bounded by the vast King Ranch; the fact that one of the directors of Celanese is related by marriage to the Kleburg family, which controls the 1,250,000-acre ranch, may have been a factor in selection of the site.

The new industrial activity extends along the Texas Gulf Coast all the way to the Mexican frontier. At Brownsville both natural gasoline and oxygenated aliphatic chemicals are to be produced at the Carthage Hydrocol plant scheduled for completion by the end of 1949. The plant will use an improved Fischer-Tropsch process to take synthetic gasoline, Diesel oil, and industrial alcohols from the more than seven trillion cubic feet of proved natural-gas reserves in the lower Rio Grande Valley. This plant, which is financed by an 18½-million-dollar RFC loan, and the other two major chemical plants under construction near by are said to represent a total new industrial investment in this area of more than 50 million dollars.

Nowhere is industrial interrelationship better illustrated than at Baton Rouge, where the huge, 40-year-old Esso Standard refinery north of the city has recently gathered about it a brood of lesser manufacturers, each dependent on one of the others either for raw materials or for market. Alkali and chlorine production finds its principal market in the refinery and the alumina plant. Other chemical plants supply sulphuric acid, hydrofluoric acid, and industrial alcohol. The Ethyl Corporation's tetraethyl lead production, three times that of the nation's only other such establishment, at Deepwater, N. J., furnishes antiknock compounds for gasoline. The company also produces here hydrochloric acid, metallic sodium, chlorine, and sodium sulphate (salt cake), together with ethylene dibromide and ethylene dichloride, which constitute more than one-third of the weight of tetraethyl lead compounds.

SULPHUR

The superabundance of sulphur on the Gulf Coast has not been a particular attraction to industry. Sulphuric acid, the chief end product of sulphur,

is almost always manufactured close to the market. However, as a result of increased lead prices, plans were announced in 1949 for the establishment of a large titanium oxide plant on the Mississippi River near New Orleans to make white paint pigment from imported Indian ilmenite. The choice of location is explained by the immense quantities of sulphuric acid used in the process and the proximity of Louisiana's Grande Ecaille sulphur mines.

SOME NONCHEMICAL INDUSTRIES

Industrial utilization of second-growth southern pine and hardwood has increased with the decrease of reserves of virgin saw timber. Sulphate-process pulp production began in the South in 1911 at Orange, Tex. Important kraft-paper centers in the Gulf South are located at Bastrop, Springhill, and Bogalusa, La., Pascagoula, Miss., and Mobile, Ala. The pioneer newsprint mill in the South, which opened at Lufkin, Tex., in 1940, remains the only one, though a second is scheduled for completion in 1950 at Childersburg, in central Alabama. At Houston both food-container stock and high-grade coated white paper are produced from bleached sulphate pulp in a large new plant on the Ship Channel.

Texas, since the war, has had its own iron and steel industry. The 60-million-dollar Sheffield plant on the Houston Ship Channel, in part government financed, has one blast furnace and seven open hearths and employs some 3 500 persons. Most of its output is marketed in Texas and Louisiana; the oil-field-equipment producers in Houston are an important outlet. Another government-built blast furnace recently purchased by Texas capital at Daingerfield, in the East Texas piny woods, is to be supplemented by steel-making facilities in the near future. East Texas hematite ores and Oklahoma coking coals supply the raw materials for both plants. Some Mexican ore has been received at Houston.

Although Texas and Louisiana together produce one-quarter of the nation's cotton, they are both net importers of cotton textiles. The apparel industry is of importance in Dallas, which has become the South's style center for women's wear, and also in San Antonio and many smaller centers where low-wage, nonunion labor is still available.

Of particular significance to the agricultural economy of the region is the new Corn Products Refining Company plant at Corpus Christi, which is producing dextrose sugars, starches, and protein feed from 600 million bushels of dwarf grain sorghum a year.

A meat-packing industry at Fort Worth, shipbuilding at Mobile, fruit and vegetable canning in the Rio Grande Valley, and the refining of both domestic and imported sugar cane and molasses at New Orleans are other

localized industries in the Gulf South. Three of New Orleans' largest industrial plants produce building materials. At Dallas there is an automobile assembly plant where each car carries a windshield sticker "Made in Texas by Texans" as it leaves the assembly line; at Longview, Tex., there is a large new earth-moving-equipment plant.

The Gulf Coast, 1000 miles closer, by way of the Panama Canal, to the Galápagos-Central America fishing grounds than California ports, is well located for the development of a tuna-canning industry, and plans have been announced for canneries at Houston and at Pascagoula. Outfitting of tuna boats is said to be cheaper than at San Diego or San Pedro.

THE AIRCRAFT INDUSTRY

Geographical dispersion of strategic industrial plants is being increasingly dictated by both economic and military considerations. As compared with the more vulnerable Atlantic and Pacific coastal cities, the Gulf South is in a favored position. During the war Texas and Louisiana received important new aircraft manufacturing industries. The huge Higgins and Consolidated Vultee facilities at New Orleans have since been converted to other types of production, but in Texas the two major establishments have continued in operation as aircraft plants.

The more important of these, and the largest industrial employer in the South, is the giant government-owned Consolidated Vultee plant a few miles northwest of Fort Worth. In mid-1949 it was employing 14,000 persons in three shifts. Production began in 1942, just one year after ground was broken, and by November, 1943, employment had reached a peak of 30,600. The choice of location was related in part to the company's plans for the future manufacture of flying boats, which might be test-flown from an adjacent lake, in part to the existence of a military airfield of a length adequate for B-29's. Labor was recruited almost entirely from Texans, though key men were brought from Consolidated's San Diego plant and some thousand new employees were sent to California for training with the understanding that they would return to the Fort Worth plant.

The former North American bomber assembly plant at Grand Prairie, midway between Fort Worth and Dallas, is occupied by two aircraft companies. The larger, Chance Vought, moved its entire establishment here from Stratford, Conn., in 1948-1949, including 1300 Connecticut employees, with their families and belongings. The rest of the company's 5600 employees are Texans. This unprecedented move from the congested Connecticut coast

to the Texas plains required 1006 freight cars and was undoubtedly dictated, in part at least, by strategic considerations.

INDUSTRIAL PROMOTION

Promotional activity by local and state agencies, utility companies, and organized industrial districts has been intense in the Gulf South and has probably influenced the location of many new concerns, particularly in the consumers' goods industries. A bond issue approved by Fort Worth voters made possible the purchase of the 1450 acres of land required for the Consolidated aircraft plant. One popular device has been the nonprofit industrial foundation that builds plants to industry's specifications and then rents them on low-cost, long-term leases. Mississippi counties and municipalities are empowered to raise funds through special bond issues for this purpose under the widely publicized "Balance Agriculture with Industry" Act of 1944. Louisiana, with a somewhat unsavory political reputation and an unfavorable tax structure as compared with neighboring Texas, has offered 10-year exemptions from both state and local ad valorem taxes on all new industrial establishments. Between December, 1945, and July, 1949, such exemptions were granted on 381 million dollars' worth of new facilities, which, according to the State Department of Commerce and Industry, should eventually provide 31,686 new jobs.

The economy of the Gulf Coast is still largely oriented to the production of raw materials and staple, heavy-tonnage chemical and petroleum products. Substantial expansion of the regional market, both in numbers and in buying power, would seem imperative before either Texas or Louisiana can take its place alongside the manufacturing states of the North and East. Yet the Gulf South's resource base and its location with respect to world markets and trade routes are much superior to those of California, for example. Overdraft has caused an alarming drop in certain East Texas water tables, but conservation measures and utilization of surface runoff should provide relief at not too great a cost. Although the menace of destructive hurricanes and tidal waves along the low coastal margins is real, improved forecasting techniques in recent years help to discount the danger.

The future of the region lies with the oil and gas reserves, with the geophysicists, the wildcatters, the reservoir engineers, and the recovery technologists. The longer the subsurface deposits of hydrocarbons can be made to last, the closer the cities of the Gulf Coast should be able to approach to their cherished "industrial destiny." Without this resource base their whole economic structure must almost inevitably crumble.

EVIDENCE FOR PLEISTOCENE MAN IN SOUTHERN CALIFORNIA*

GEORGE F. CARTER

IT IS well known that the sea margin was a superior location for primitive man. In an area so situated that it has remained near the shore despite fluctuations of level, one might expect to find a relatively long and complete record of early man. At La Jolla, Calif., there is such a site. Vertical fluctuations of 300 feet would move the shore line only a small distance laterally—not more than three-quarters of a mile. At the base of the 300-foot scarp of the Linda Vista Mesa is an alluvial fan, now being actively destroyed by wave attack. Exposed in its truncated seaward face, 20 to 30 feet high, is evidence that man lived at La Jolla throughout most, if not all, of the period when the fan was being built.

EVIDENCE OF MAN

In the upper part of the fan the evidence consists of mollusk and other shells, charcoal in hearths, man-made stone flakes, and a mano. Hearths, flakes, and shells are found throughout the 20-foot exposed depth. In the top of the north wall of a gully cut through the fan there was formerly a concentration of shell sufficient to warrant the term "midden." The remaining three cubic yards of this material was excavated in 1947 in order to salvage it before the sea cut the cliff back farther. The midden was associated with a developed soil profile. The A horizon contained a quantity of rock-oyster shell. The midden proper lay in the B horizon and extended into the upper few inches of the C horizon. It contained principally mussel and abalone shell. None of these shells can be found in this area today, though they can

*This paper is an outgrowth of an attempt to solve the problem of the antiquity of man in Southern California. It is a continuation of a study of early man begun in 1930 and carried on from 1934 to 1938, when I was employed by the San Diego Museum of Man. In the summers of 1947 and 1948, I returned to San Diego to resume work on this problem after a period of study in geography and a long diversion caused by various wartime activities. Mr. Malcolm F. Farmer, the present director of the San Diego Museum of Man, placed every facility of the museum at my disposal and allowed me access to site notes and materials. I am also indebted to the museum for Figure 3, which was taken by my good friend the late F. S. Rogers. Drs. Carl L. Hubbs and F. P. Shepard of the Scripps Institution of Oceanography have been interested and helpful. The field work was made possible by grants-in-aid from the Department of Geography, The Johns Hopkins University. This is a preliminary report to be followed in due course by more detailed papers.

► DR. CARTER is professor of human geography and chairman of The Isaiah Bowman School of Geography at The Johns Hopkins University, Baltimore.

be obtained in small quantities from the few rocks a quarter of a mile north and in larger quantities from the rocks about La Jolla beginning one mile to the south. It is clear that in later times the Indians of the region depended on a water supply nearer La Jolla and its abundant shellfish. If the occupation of the midden coincided with a low sea level, as seems probable, the rocky walls of the adjacent La Jolla submarine canyon could have been the source of the mussels and abalones.

Broken stone was moderately common in the midden, but the developed artifacts common on younger sites in this area were lacking. No pottery, arrowheads, blades, or other developed artifacts were found, nor were any found in 1947 and 1948 on the surface or in the interior of the fan with the single exception of the mano. This is the more surprising in that the area toward La Jolla bears evidence of a former large Indian population, who might well have dropped occasional artifacts on this fan surface. It is possible that the full artifact complex of man at this site has not been recovered. Probably the materials recovered about the scattered hearths represent only the fringe of occupancy of a major campsite that has been destroyed by erosion of the cliff. However, the absence of developed artifacts in the remnant of midden excavated and the presence in this area of similar middens also lacking developed artifacts indicate the probability of an early culture possessed of very few imperishable materials.

The mano was found 400 feet south of the midden at a depth of five feet. It is unique only in its probable great age. It is a plano-convex granite cobble with its flat side worn and sharpened. Although this is as primitive as a mano can be, such manos are also found on modern Indian sites. Near the mano was a smooth egg-shaped cobble; both were embedded in the base of the dense clay layer of a buried soil horizon. The possibility of intrusion of artifacts always exists in anything softer than rock, and careful study was made to determine whether there was any evidence of disturbance. Ground squirrels are active in this area, though most of their activity is concentrated in the softer fills of the old gullies rather than in the tougher soils. Dr. Carl Hubbs was called to witness the find, and he verified my judgment that there was no evidence of intrusion of the artifact or of the adjacent smooth stone.

Careful study has shown that the depth of burial of the materials is not particularly significant, since the fan has been subjected to repeated erosion and deposition, and some of the deeper materials are younger than some of the higher materials. In the basal part of the fan only hearths are found. The upper materials are admitted by those familiar with the archeology of

Southern California as evidence for man.¹ The hearths in the lower part, unaccompanied by any material attributable to man, are less convincing. The absence of shell is inconclusive, since it may have been leached out. The absence of flaked stone may also be inconclusive, since evidence for man's not using stone is to be found elsewhere in this area. Fire alone, however, is slim evidence for human occupation.

The reasons for thinking that these traces of fire indicate man are their shape, distribution, and associations. Isolated hearths occupy basin-shaped areas containing charcoal. The earth of the basin is characteristically baked to a brick-red color. Similar evidence is found in lenses that may extend for six or eight feet along the face of the cliff. The fire lenses tend to be concentrated in certain places. In one place there are five overlying fire levels within a vertical distance of three feet. Some of them are as much as four inches thick and contain charcoal pieces as much as an inch in diameter. When one lens is only four inches above another and the lower one is undisturbed, natural burning is scarcely likely to be the cause. Moreover, this area is not now, and probably was not in the past, one where fires occur naturally with any frequency.²

Three unshaped blocks of sandstone were found where fire lenses were concentrated, one measuring 18 by 6 by 8 inches. Such large material is foreign to the fan in general and unknown in its face, even in the former erosion channels, which carry sizable igneous cobbles. In the hearth areas the alluvium is a fine sandy loam free of all but occasional small pebbles. The size of the blocks, their material (the other gravels are igneous rocks), and their association with hearths all suggest that they were brought here by man. One piece of sandstone shaped like a mano, but so weathered that its surface showed no evidence of wear, had been burned a brick red. It was not in a fire lens, but isolated in loamy unstratified alluvium. In similar formations one-fourth of a mile north, animal bones have twice been found in similar fire lenses.

¹ This site has been under observation for many years, and numerous archeologists and others have examined it, among them M. F. Farmer, T. Cain, and C. Tuthill, all of the San Diego Museum, S. L. Rogers of San Diego State College; Carl L. Hubbs and F. P. Shepard; and T. Sayles of the Arizona State Museum. In 1947, R. L. Pendleton, who in 1915 had made the original soil survey of San Diego County, spent a day in the field with me examining sites and soils, paying special attention to this location. The site was called to my notice in 1934 by M. J. Rogers, then curator of the San Diego Museum. The conclusion for a Pleistocene age for these materials is my own.

² On the coast of Southern California there is probably not more than one thunderstorm a year. This comes in the winter rainy period and, in all cases that I have observed over a period of years, has accompanied a sharp cold front following a long, soaking rain. This seems a highly unlikely source for natural fires.

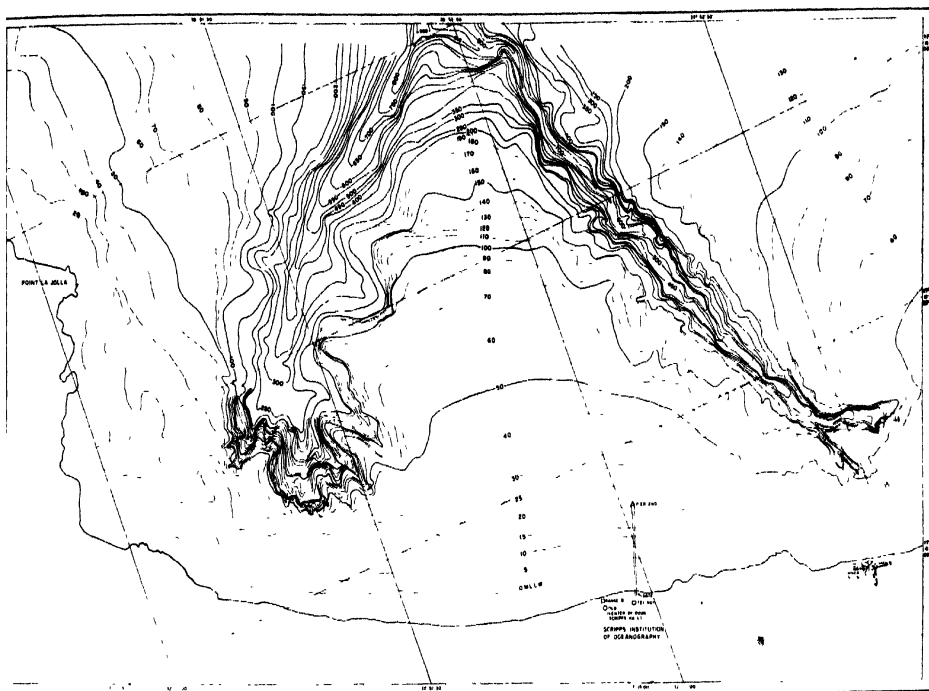


FIG. 1—Submarine topography off La Jolla; La Jolla Canyon on the left, Scripps Canyon on the right. (From blueprint map compiled by the Scripps Institution of Oceanography.)



FIG. 2—Physiographic block diagram of the San Diego and La Jolla quadrangles and some of the mountainous region to the east. (Drawn by E. H. Quayle and reproduced by permission from "The Geology and Paleontology of the Marine Pliocene of San Diego, California," Part 1, "Geology," by L. G. Hertlein and U. S. Grant IV, *Memoirs San Diego Soc. of Nat. Hist.*, Vol. 2, 1944.)

None of this evidence is conclusive, and the traces of fire in the basal part of the fan must be regarded only as possible, or at best probable, evidence for man. The material in the upper part is unquestionably evidence for man's presence. The question to be answered, then, is the age of the alluvium in which this material is buried. Suggestions are to be found through study of the morphology and pedology of the fan.

MORPHOLOGY OF THE FAN

The fan has been under observation by the Scripps Institution of Oceanography for 28 years. In this time the cliff face has retreated 29.5 feet.³ Evidence now accumulating indicates a recent general glacier recession⁴ and a concomitant rise of sea level.⁵ It is probably significant that the fan has been rapidly retreating in this period of rapidly rising sea level; at any rate, it could not have been built under the existing conditions. The underwater topography seaward of the alluvial fan has been revealed as a wedge-shaped shelf with its broad arc toward the beach and the Scripps and La Jolla submarine canyons forming its radii (Fig. 1). The underwater contours suggest that the fan continues seaward under the water, projecting into the angle formed by the convergence of the canyons.⁶ They also suggest a maximum extension slightly more than half a mile seaward of the present shore, for at that distance the shelf steepens toward the canyon convergence.

It is, of course, possible that the heads of the canyons have cut back into the fan materials since their deposition. Dr. F. P. Shepard informs me that there are unconsolidated alluvial materials in the head of the La Jolla Canyon. But the fan materials accumulated on the shelf between the canyon heads,

³ F. P. Shepard and U. S. Grant IV: Wave Erosion along the Southern California Coast, *Bull. Geol. Soc. of America*, Vol. 58, 1947, pp. 919-926; reference on pp. 924-925.

⁴ From lectures delivered by H. W. Ahlmann at the Johns Hopkins Department of Geography, 1947. Evidence for the rapid retreat of the glaciers of the North Atlantic was presented, and guests just returned from Antarctica and Canada added evidence for the rapid retreat of glaciers and of frozen ground in those regions. See also H. W. Ahlmann: Glaciological Research on the North Atlantic Coasts, *Royal Geogr. Soc. Research Ser. No. 1*, 1948 (reviewed by Gordon Manley, *Geogr. Rev.*, Vol. 39, 1949, pp. 136-138); J. L. Dyson: Shrinkage of Sperry and Grinnell Glaciers, Glacier National Park, Montana, *Geogr. Rev.*, Vol. 38, 1948, pp. 95-103; W. O. Field, Jr.: Glacier Recession in Muir Inlet, Glacier Bay, Alaska, *ibid.*, Vol. 37, 1947, pp. 369-399.

⁵ H. A. Marmer: Is the Atlantic Coast Sinking? The Evidence from the Tide, *Geogr. Rev.*, Vol. 38, 1948, pp. 652-657. Marmer does not state unequivocally that the sea level is rising, though all his evidence indicates that it is. He points out that the effect of a rising sea would be created if the Atlantic coast were sinking while sea level remained fixed. He fails to note that the Atlantic coast is geologically heterogeneous, which would make it difficult to account for the rather uniform data he presents for the coast from Maine to Florida. Neither does he consider the world-wide evidence for recent accelerated glacial melt.

⁶ F. P. Shepard and K. O. Emery: Submarine Topography off the California Coast: Canyons and Tectonic Interpretation, *Geol. Soc. of America Special Paper No. 31*, 1941, Plate 9 (facing p. 64).

and growth of the heads would seem to affect only the margins of the fan. Retreat of the canyon walls at the convergence could, however, have shortened the shelf on which the fan originally accumulated. The assumed maximum extension of half a mile seaward of the present shore is in accord with the projection of the fan remnant on the gradient of a normal fan. The depth of water at the probable outer edge of the fan would be 100 feet, which may be taken as the approximate minimum lowering of the sea in relation to the land necessary to expose the shelf and permit the fan to grow.

The evidence for the origin of the fan may be stated as follows: At a time when the sea stood in relation to the land 100 feet or more lower than at present, a gently sloping platform about three-quarters of a mile wide was exposed at the foot of the 300-foot cliff terminating the seaward side of the Linda Vista Mesa. Alluvium from the mesa was deposited where a small canyon opened onto the shelf, the gradient was sharply reduced, and an alluvial fan was built up. A subsequent rise of sea level in relation to the land exposed the unconsolidated alluvium to wave attack, and it retreated about half a mile.

In other areas there might well have been complicating factors governing the rate of retreat, such as the width of the protecting beach, the presence of offshore bars, and the amount of sand supply to the beach. Here, however, the bordering submarine canyons prevented alongshore transport of sand to feed a protecting beach until the sea level approached its present position in relation to the land. Further, the steep plunge from the outer margin of the shelf into the canyon depths precluded the development of offshore bars in the early stages of retreat. Nor are there offshore bars today, and the depth of sand on the present beach in front of the truncated fan is shallow. The retreat of the fan may, then, have been rather simply and directly influenced by the rate of rise of sea level above the edge of the shelf.

GULLYING OF THE FAN

A deep longitudinal gully seems to be causally related to the truncation of the fan. The mechanism by which it has been formed is shown diagrammatically in Figure 4. If the fan was built when the sea level was at the line AA' , a rise of sea level to BB' would lead to recession of the fan under wave attack and the formation of a sea cliff at some point such as CE . This would change the gradient of the stream that built the fan from $ABCD$ to DE , a great steepening, which together with the formation of the cliff would expectably result in gully cutting.

The present truncation of the fan permits examination of its inner struc-

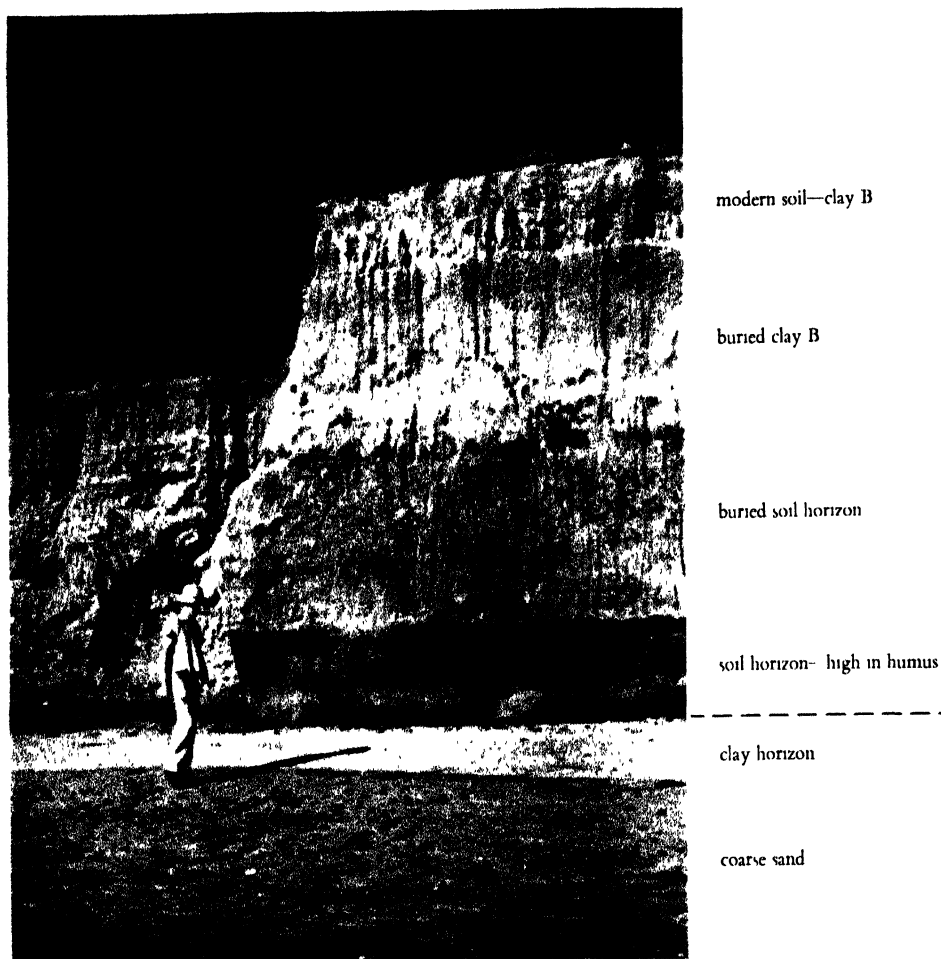


FIG. 3—Cliff face of the La Jolla fan. Strata underlying the dark layer exposed at beach level are determined from drillings for cesspools. (Courtesy San Diego Museum of Man.)

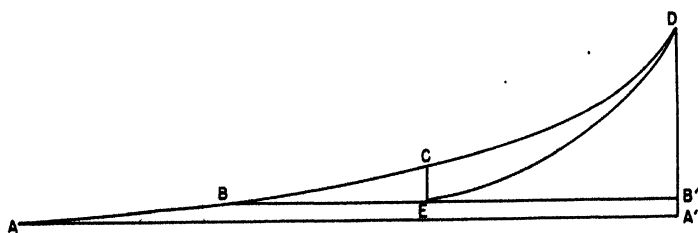


FIG. 4—Diagram of gully formation.

ture. The face of the cliff shows marked horizontal bands of differing sedimentary materials (Fig. 3), which are, however, not continuous. Gullies comparable to the existing one were cut and then refilled as the fan resumed growth. Careful mapping reveals three major periods of alluviation and of gully cutting. These are shown diagrammatically in Figure 5.

In terms of the mechanics of accumulation versus truncation and gully cutting the sequence of events would seem to call for three cycles of low sea (or high land) level followed by high sea (or low land) level. This would require a very active crustal movement. The final period, the present, is known to be a time of rising sea level; the other fluctuations may also have been due to changing sea level rather than changing land level.

The question may be raised whether some other mechanism than alternation of fan height in relation to sea level could not have caused the gullying; for example, changes in the runoff conditions on the fan or on the drainage basin. Fire, with its attendant removal of plant cover and consequent accelerated runoff, is a possibility. However, field observations⁷ incline me to the belief that, particularly in its initial phases, increased runoff on the watershed is much more likely to lead to increased deposition on the fan surface. This is true for most of the alluvial fans in this area that have had their source areas and their depositional surfaces stripped by agriculture.

It is possible that unusually heavy rainfalls gave rise to flash floods that cut gullies. However, the fan materials show remarkably little evidence of intense flooding at any time. The materials, even in the upper, steeper part of the fan, are fine sands and silts, except for occasional small lenses of coarse sands with small gravel. Only in the bottom of the present and past gullies, where the entire runoff of the watershed is concentrated, are there to be found six-inch cobbles, derived from the older formations in the drainage area. And such cobbles are being rolled down the present gully by the present moderate rains. Moreover, the drainage basin for the fan is only 160 acres in extent, whereas the surface on which the runoff was dispersed was probably

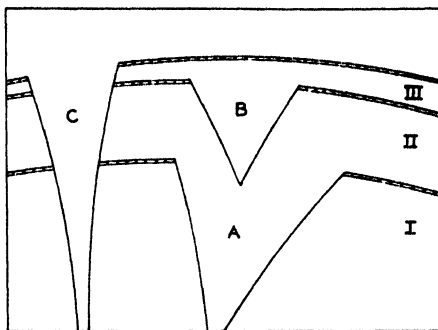


FIG. 5.—Periods of alluviation and gullying.

⁷ G. F. Carter: Lima Bean Farming and Soil Erosion in the Encinitas Area, *Yearbook Assn. of Pacific Coast Geogr.*, Vol. 4, 1938, pp. 15-20.

twice as large. The conditions, then, are not particularly conducive to gully cutting by floods.

Bryan and Hack and others have interpreted gullies in the arid Southwest as the result of climatic changes. It is doubtful whether their arguments apply here. They were dealing with the erosion of major valleys, where the primary erosion factor is the volume of water flowing down a relatively uniform gradient, whereas erosion of a fan at the base of a cliff or mountain range is ruled primarily by the change of gradient that takes place there. Further, since fans in arid regions are probably built mainly by floodwaters, floods seem an unlikely source for their destruction.

EUSTATICALLY FLUCTUATING SEA LEVEL AND THE FAN

The question of land or sea stability is capable in part of simple solution. The sea level is known to have changed during the Pleistocene by the addition and subtraction of water due to the melting or the accumulation of ice. The sea level is now rising, because of the addition of meltwater. Sea level during a glacial period can never have been fixed, for the glaciers waxed and waned within each glacial period. The answer to the question is that the sea level has surely been fluctuating, the land level may have been. The movement of sea level can be assumed; changes of land level must be proved.

Let us assume a relatively stable land mass and consider the effect of a eustatically fluctuating sea level in the particular situation at La Jolla. To initiate accumulation of materials on the platform between the juncture of the La Jolla and Scripps Canyons and the foot of the 300-foot terrace, a fall of sea level of 100 feet below present sea level would have been required. And this presumably happened several times.

For gully cutting to begin, the sea must have risen within 100 feet of its present level. Since there have been at least three periods of gulying, including the present one, this indicates that at least twice during the period of accumulation of material on the fan, the sea came within 100 feet of its present level. It has been estimated that the ice now remaining on the earth would, if melted, raise the level of the sea 100 feet. This suggests that the accumulation of approximately twice as much ice would have been necessary to lower the sea to the canyon threshold, where the balance between erosion and accumulation would become critical. Stated inversely, when the icecaps were reduced from their full extent to approximately double the amount of ice now on the earth, the critical level for gully cutting was approached. However, our knowledge of the amount of ice now on the land seems to be uncertain; it may be greatly overestimated. Furthermore, information con-

cerning the true depth of the outer edge of the fan materials at La Jolla needs to be checked. But the line of reasoning seems fruitful.

THE EVIDENCE OF CRUSTAL STABILITY

Crustal stability is a problem that needs local investigation. The evidence from this particular area suggests a relatively stable coast. This is remarkable, since the coast to the north is thought to have been, and to be, in active movement.⁸ However, a striking feature of the San Diego region is the extent of flat terraces, known locally as "mesas" (Fig. 2). These were originally a continuous land surface and are even now only slightly interrupted by steep-sided river valleys that cut across them from east to west. This land surface extends as far as 10 miles inland and is clearly expressed for 20 miles north and south. It ranges in altitude from 350 feet on its seaward margin to 450 feet on its inland margin, where it abuts higher terraces. The surface is capped by a characteristic red sand and gravel formation, the Sweitzer formation,⁹ which is untilted and in which only one possible fault with a throw of three or four feet has been observed.¹⁰ The Sweitzer formation was probably deposited at the time the flat surface was formed. Its age is thought to be upper Pliocene or basal Pleistocene. Its existence argues for very considerable stability for a period far longer than that needed for the construction and destruction of the La Jolla alluvial fan.

Further evidence suggesting stability is to be found in the lower terraces cut into the seaward face of this high terrace and in the alluvial benches in the valleys crossing it. Detailed studies are in progress, and these remarks are only preliminary.

When the more recent terraces are traced along the sea front, little evidence of faulting is found. For example, in the vicinity of the La Jolla caves buried beaches at elevations of 50 to 60 feet cross faults in the underlying rock but are not displaced.

Precise leveling is needed to establish the presence or absence of tilting

⁸ W. C. Putnam: Geomorphology of the Ventura Region, California, *Bull. Geol. Soc. of America*, Vol. 53, 1942, pp. 691-754; W. P. Woodring, M. N. Bramlette, and W. S. W. Kew: Geology and Paleontology of Palos Verdes Hills, California, *U. S. Geol. Survey Professional Paper* 207, 1946

⁹ The Sweitzer formation was named by Hertlein. The statements concerning its position and age are taken from L. G. Hertlein and U. S. Grant IV: The Geology and Paleontology of the Marine Pliocene of San Diego, California, Part 1, Geology, *Memoirs San Diego Soc. of Nat. Hist.*, Vol. 2, 1944, pp. 63-66. It is possible that Hertlein and Grant's definition of the Sweitzer formation needs some restriction, but the existence of a characteristic horizontal sandstone and conglomerate capping of the San Diego Pliocene is unquestionable

¹⁰ Field notes. Observable in the west wall of the highway cut at Torrey Pines, where the formation though resembling the Sweitzer, may be older.

in the La Jolla area, but the following observations are pertinent. North of the San Dieguito River, which is eight miles north of the alluvial fan with which we are concerned, a dip averaging 10 feet in a mile is noticeable in the 60-foot beach. In the eight miles south from the San Dieguito River to the alluvial fan no such dips have been noted. The presence of a 25-foot beach adjacent to the fan and of a 25-foot terrace at the south end of Point Loma, 12 miles south of the fan, together with traces of beaches 25 feet above present sea level in the intervening area seems further evidence for crustal stability in this immediate vicinity.

The river valleys from the Sweetwater to the San Dieguito, a distance of 25 miles, all bear evidence of repeated filling and erosion after they were cut through the higher terraces. The most prominent of the fills is at 100 feet above sea level. It is suggestive that, in other areas where relative crustal stability has been postulated and terraces and valley fills have been interpreted as related to eustatic sea-level fluctuations, a 100-foot level is indicative of middle Pleistocene time. It is also suggestive that there are traces of beaches at 25 and 60 feet which are morphologically younger than the 100-foot level; for these two levels have likewise been advanced as markers of the third interglacial sea stand.

Such evidence supports the possibility that the La Jolla alluvial fan was built at the time of eustatically lowered sea level coincident with the last glaciation instead of being related to a rise of the land level sufficient (100 feet or more) to expose the shelf at the head of the La Jolla submarine canyons. Attention is again called to the fact that the fan is being destroyed today during a period of melting ice and rising sea level.

Also, if the theory that alternate gulying and alluviation are due to changes in land and sea relations is correct, it will be necessary to postulate six vertical crustal movements of 100 feet or more alternately up and down to account for the observed phenomena. All this movement would have had to occur in late Pleistocene and Recent time and should have left clear evidence along the coast, especially as depositional features in the river valleys. No such evidence has been found.

Upson¹¹ has recently reported on his studies in the Santa Barbara area. He presents a picture of alternate valley filling and gulying much like that of the region about La Jolla. He considers the Santa Barbara region to have been stable since middle Pleistocene time and interprets the alternate valley

¹¹ J. E. Upson: Late Pleistocene and Recent Changes of Sea Level along the Coast of Santa Barbara County, California. *Amer. Journ. of Sci.*, Vol. 247, 1949, pp. 94-115.

filling and cutting as due to eustatic sea-level fluctuations. The agreement in the findings for the two regions suggests that the California coast is complex and that the tendency to regard the entire coast as unstable is unjustifiable.

From the evidence now at hand the following conclusions seem indicated: The low elevation of the La Jolla fan in an area marked by 25-, 60-, and 100-foot beaches and terraces indicates that it is younger than these sea stands. The evidence for relative crustal stability in this area throughout at least the upper Pleistocene and the lack of evidence for any other mechanism creating the pattern of alternating gullying and filling taken with the known sea-level fluctuation suggest that the causal factor in the cycle of gullying and filling may well have been a fluctuating sea level against a relatively stable land mass. If such is the case, the fan must have been built during the last eustatically lowered sea level—in glacial chronology, Wisconsin time.

If, then, the erosions and depositions observable in the upper sections of the fan are to be thought of as consequent to fluctuations of the terminal Wisconsin ice masses, the question is raised of the distribution in time of these glacial fluctuations. The depositional history of the fan might be expected to bear evidence on this matter.

INTERNAL STRUCTURE AND TIME

The ease with which old surfaces can be traced through the length of the fan face is evidence that none of the erosions was so extensive as to remove all the original fan surface. The least-interrupted surfaces are the deeper, earlier ones. The tops of these strata represent pauses in the construction of the fan and may well have been associated with minor gullying such as is apparent at the south end of the presently exposed cliff. Or they may be associated with gullies now concealed by the sea wall that masks the southern one-third of the fan. Further evidence in support of this will be presented in the discussion of soil types.

After this period of deposition, which accounts for about one-half of the exposed bulk of the fan, a period of erosion occurred, reflecting according to our present assumption a sea rise within 100 feet of present sea level. Since this would have been a rise of some hundreds of feet above the probable sea level at the time of the glacial maximum, it must have represented a very large ice melt. The gullying marking this erosion is the most extensive recorded in the fan. More gullies, involving larger amounts of the fan surface, were cut than at any subsequent time. The walls of some of the gullies assumed gentler slopes than those characteristic of later gullies. All of this suggests a relatively long period of time.

As was noted earlier, this period of erosion was followed by a period of deposition, which filled the gullies and buried the old fan surface. The new surface in its turn was gullied and weathered. This too suggests passage of considerable time. The last period of deposition was ended by the cutting of the present gully coincident with the present rise in sea level. The land surface created by the last deposition has been considerably weathered.

Thus the upper half of the fan material has accumulated only after prolonged erosion and deposition, as compared with the relatively uninterrupted depositional history of the lower half. Further, the large amount of weathering of the land surfaces (interfluves) between the gullies in the upper half suggests that the interruptions to deposition were much longer than those indicated by the relatively unweathered surfaces evident in the lower half. All these factors suggest that the period of time represented by the upper half of the fan is considerably longer than that for the lower half. An uncertainty enters here, inasmuch as the base of the fan is not exposed. Well borings in the vicinity, however, suggest that its base may not be far below the present beach level and that it may rest on sands of a former sea beach.

EVIDENCE FROM SOILS

There should be evidence of the sequence of events outlined above in developed soil profiles marking the weathered surfaces on and within the fan. Since the strata within the cliff were all deposited on a curve corresponding to the cross section of a normal fan, and since the apex of the fan has varied from one period of alluviation to another, it follows that although the sequence of strata remains constant except where erosion has broken the horizons, the vertical distances between the strata cannot be the same from one part of the cliff to another. The sequence described here is uninterrupted. It occurs near the south end of the present cliff, about 26 feet north of the north end of the concrete sea wall that obscures the evidence farther to the south. The strata are described from the surface downward.

- Stratum 1. Loose humus-charged sandy loam. 12 to 16 inches thick.
- Stratum 2. Dense dark-gray clay that cracks upon drying into a pronounced columnar structure. 8 to 10 inches thick.
- Stratum 3. Less dense clay that develops some vertical cracks and contains lime accumulation in seams and nodules. Grades into the sandy loam below. 12 inches thick.
- Stratum 4. Sandy loam. 2 feet thick.
- Stratum 5. Dense clay similar to stratum 2, with a cubical structure when dry. 2 feet thick.
- Stratum 6. Less dense clay that grades into the underlying sandy loam and contains lime accumulation, as in stratum 3. 12 to 18 inches thick.
- Stratum 7. Sandy loam similar to stratum 4. 6 feet thick.

- Stratum 8. Light-brown fine sandy loam. 12 inches thick.
- Stratum 9. Yellow clay loam containing some clay accumulation. 12 inches thick.
- Stratum 10. Yellow loam with some red and gray mottling. 3 feet thick.
- Stratum 11. Tough yellow loam mottled with reds and browns and grays; top marked by dark-brown band or bands. 3 feet thick.
- Stratum 12. Tough yellow-brown loam mottled with reds and browns and grays; top marked by dark-brown layer with maximum thickness of 2 feet. At beach level at south end of the cliff but exposed to the north to a thickness of 7 feet.

When the upper and lower materials are compared, a change in the climatic conditions under which the alluvium accumulated seems indicated. From the top of stratum 8 down, the materials have an increased toughness due to greater clay content. Strata 10, 11, and 12 contain dark-stained horizons, interpreted as due to humus that accumulated during relatively short pauses in the growth of the alluvial fan. These humus-stained horizons are thought to represent young soil profiles. The absence of humus staining above stratum 8 suggests that the climate had changed in such a way as no longer to support a heavy vegetation cover; in other words, that the upper strata were deposited during a drier period than prevailed when the lower strata were deposited.

The differences in chemical weathering processes active at the time of the accumulation of the alluvium above and below the line of demarcation afford confirmation. Below stratum 7 the materials are mottled reds, browns, and grays, an indication of sufficient moisture to wet the soil mass through for long periods, with resulting unequal reduction and oxidation of its minerals—characteristics of soils developed under a warm humid climate (the runoff concentrated on the fan would, however, give a more humid aspect to the soils). It might be thought that the source of moisture was the sea water, which now approaches these levels. However, the mottled materials can be traced up the present gully well above sea level. And the fill of gullies formed during the arid period, though now near sea level, does not show mottling.

Above stratum 8 no such evidence is to be found. The materials are lighter in color and low in clay content except in illuvial soil horizons, and some strata show pronounced lime accumulation. These are characteristics of soils developed under an arid climate. There is no proof that the climatic change was sudden. Strata 7 and 8 are separated by an erosion period representing an appreciable interval of time. Soil tests are planned to determine the degree of change between strata.

Table I is a diagrammatic profile. The horizons can be compared with those described in the soil surveys of California. The soil on the fan is mapped

in the "Soil Survey of the El Cajon Area, California" as Huerhuero fine sandy loam and described as follows:

Typically the surface soil is light brownish-gray or light grayish-brown friable fine sandy loam ranging from 7 to 14 inches in thickness. . . . The subsoil to a depth ranging from 20 to 30 inches consists of brown or dull-brown compact clay loam or clay. . . . The lower part of the subsoil is light-brown clay loam or clay, that has a concentration of calcium carbonate in nodules and in the soil cracks. The calcareous layer ranges from 18 to 24 inches in thickness. The soil material below the calcareous layer consists of light yellowish-brown slightly compact clay loam or fine sandy loam.¹²

TABLE I

TEXTURE & STRUCTURE	SOIL HORIZONS	DEGREE OF SOIL DEVELOPMENT	CLIMATE
		MODERN GULLY	ARID
1 fine sandy loam 2 columnar clay 3 calcareous clay 4 sandy loam	A B ₁ B ₂ C	Mature soil	
		BURIED GULLY	
5 cubical clay 6 calcareous clay 7 sandy loam	B ₁ B ₂ C	Mature soil	
		BURIED GULLY	
8 fine sandy loam 9 clay loam 10 mottled clay loam	A B C	Young soil	
11 clay loam { dark mottled	A C	Recent soil	HUMID
12 clay loam { dark mottled	A C	Recent soil	

The description fits the observed profile sufficiently well to make improbable any error arising from the mapping and supports the conclusion that these horizons are developed pedological features and not depositional (geological) features.

The soils of the El Cajon area have been arranged by Storie and Carpen-

¹² R. E. Storie and E. J. Carpenter: Soil Survey of the El Cajon Area, California, *U. S. Dept. of Agric., Bur. of Chemistry and Soils, Soil Survey, Ser. 1930, No. 15, 1934, p. 30.*

ter¹³ in four groups: soils weathered in place from underlying consolidated bedrock; unweathered alluvial soils; moderately weathered alluvial soils; and maturely weathered soils. The Huerhuero soils are placed in the maturely weathered soils, all of which are characterized by

friable sandy surface soils that give way abruptly at a depth ranging from about 8 to 16 inches to heavy intractable clay which is practically impervious to air, water, or plant roots. The clay layer is underlain by hardpanlike sediments which range from unconsolidated to firmly consolidated. These soils occupy elevated terraces, and the surface relief is smooth or undulating. The group includes mainly the coastal-plain or sea-terrace soils that occupy the mesas surrounding San Diego.¹⁴

Evidence will be presented in later papers that these soils can probably be subdivided stratigraphically and pedologically and that the soil on the fan is not as fully mature as soils on older terraces in the region. For the present it will suffice to call attention to the fact that pedologists consider these soils to be mature and have recognized their connection with the relatively flat terrace surfaces of the region.

The soil of the fan represents, then, a period of prolonged weathering during which neither deposition nor erosion was active. In California, soils may be considerably weathered during the uninterrupted growth of alluvial fans. The B horizons attain great thickness and often show the effect of repeated small additions of silt layers. The A and B horizons of the fan soil, however, are rather thin, which would suggest that no deposition took place on its surface during their development. It seems probable, therefore, that the modern gully was formed before this weathering began. For, as soon as the gully was formed, all silt-loaded floodwaters would be confined to it, and deposition on the fan would cease. Under the local moderate rains during the vegetation growing season, erosion on the fan surface would be virtually nonexistent and soil development would be uninterrupted. If the gullying began with the rise of sea level within 100 feet of modern sea level, as postulated in this paper, the weathering leading to this soil development would have begun in the early Recent.

Little is known of the rate of differentiation of soil horizons. Time, climate, slope, drainage, parent material, and other factors affect the speed of the process. In general, the higher the temperature and the more abundant and constant the moisture, the more rapidly will pedological processes go forward. San Diego is now arid. Its soils would, then, expectably indicate

¹³ *Ibid.*, Table 5 (on p. 14).

¹⁴ *Ibid.*, p. 26.

arid climates through such lime accumulation as has been described. At first thought the accumulation of clay and the development of strong soil profiles are unexpected. However, the climate of the area is more accurately described as winter humid and spring, summer, and fall arid. The development of clay pans suggests that it is the brief humid period which dominates soil formation. In that case, the rate of development must be slow. One might expect it to be some fraction of the rate in areas with the same temperatures but with year-round humidity. Soil scientists consider the extreme weathering and differentiation of soil horizons to be very slow processes, requiring many thousands of years in humid lands.

THE BURIED SOIL

Strata 5 and 6 are so similar to strata 2 and 3 in material, structure, and sequence as to suggest that they are the B_1 and B_2 horizons of a former soil. Morphologically they represent the land surface that was freed from deposition and exposed to weathering upon the formation of the gully preceding the present gully. It seems significant that the thickness of the B_1 (clay) horizon of this soil is twice the thickness of that horizon in the soil on the present fan surface. The two soils have similar parent materials and similar positions in relation to runoff and drainage. That both contain lime accumulation in the B_2 horizon and similar clays in the B_1 horizon is evidence that they developed under similar climatic conditions. The differences in degree of development would seem, therefore, to be related primarily to differences in the length of time during which the soil-building processes acted. The buried soil required twice as much time for development as the surface soil.

If we possessed a reliable figure for postglacial time, we should now be in a position to make some rough calculations regarding the age of the strata related to these soil horizons. Antevs¹⁵ has estimated that the sea reached within 100 feet of modern levels about 10,000 years ago. Truncation of the fan and the consequent formation of the modern gully should date from that time. An estimate of 10,000 years for the formation of this soil might be correct. However, as Dr. F. P. Shepard¹⁶ points out, further evidence on the antiquity of the soil-horizon development is needed before final conclusions can be drawn.

A chronology based on 10,000 years as the assumed period of truncation, cutting of the modern gully, and soil formation is given in Table II. No

¹⁵ Ernst Antevs: *Shell Beds on the Skagerrack*, *Geol. Fören. i Stockholm Förhandl.*, Vol. 50, 1928, pp. 479-750, Fig. 2 (on p. 567).

¹⁶ Personal correspondence.

time has been allowed for gullying, though this was certainly not instantaneous. Only 5000 years has been allowed for the filling of gullies and the deposition of a new layer of material. Considering that the foot of the fan had to be completely rebuilt before the gullies could fill and the entire fan surface be alluviated, an allowance of 5000 years is probably minimal. Furthermore, the deposition on the fan, the surface of which is large in proportion to its drainage basin, was accomplished by an intermittent stream, and the materials in the fan indicate gentle deposition rather than thick flood

TABLE II

MORPHOLOGY AND PEDOLOGY	TIME ESTIMATES	CLIMATE
Gully	10,000 years	ARID
Mature soil		
Alluviation	5,000 years	
Gully	x-000 years	
Mature soil	20,000 years	
Alluviation	5,000 years	
Gully		HUMID
Young soil		
Recent soil		
Recent soil		

(Base of fan not exposed.)

deposits. The figure of 40,000 years ago for the beginning of the development of the buried soil may, therefore, be a minimum. An attempt to date associated materials is of interest, since it is in this horizon that evidence for man consists of such positive materials as mollusk shells, stone flakes, and the mano.

DATE OF HUMAN OCCUPATION

The evidence, then, suggests that man possessing the mano and, by inference, using the metate to grind wild seeds, eating shellfish, and possessed, so far as is now known, of only simple stone flakes lived at La Jolla something like 40,000 years ago. If the hearths found in the deeper strata are indeed evidence of man, human occupancy of this area extends back through the

Wisconsin period. One piece of evidence, to be reported elsewhere, associates man with a 25-foot beach level here. If the coast is proved relatively stable, this would indicate interglacial man and probably double the antiquity suggested above. The poverty of the materials in the alluvial fan does not suggest a people with any traces of a culture favorable to survival in a glacial-arctic climate. This suggests that bearers of this culture entered America via Bering Strait during some milder climatic period.

A final note should be appended. It is not possible to extrapolate from comparative culture levels to comparable dates elsewhere in America. California, and especially Southern and Lower California, are regions of extreme cultural lags. Such primitive cultures (in terms of imperishable materials) as we are here dealing with could well have been contemporaneous with better-developed lithic cultures elsewhere in California or America.

THE REPLIT SKERRY GUARD: EMERGING ISLANDS IN THE NORTHERN BALTIC

HELMER SMEDS

N EAR the city of Vasa, at the narrowest part of the Gulf of Bothnia, the shore of Finland is fringed by the Replot skerry guard. These islands stretch halfway out into the channel, the North Kvark, between Bothnian Bay on the north and the Bothnian Sea on the south. Because this is the lowest and most level part of the peneplained Fennoscandian shield, the bedrock is almost entirely covered with glacial and post-glacial deposits. Their undulating surface causes the highly irregular shore line of the larger islands and even creates many of the smaller islands in entirety. However, the main features of the skerry guard arise from the topography of the peneplain itself. It dips very gently below sea level, its higher knobs protruding as islands and islets 5 to 15 meters high.

THE EMERGING LAND

Postglacial upwarping is producing marked results in the Replot skerry guard, partly because of its extent—for recent times it is estimated at 90 centimeters a century, as compared with 50 centimeters a century in the skerry guard of southwestern Finland—but still more because of the gentle slopes of the submerged peneplain. Considerable areas are gradually rising above sea level and turning into dry land. Approximately every 50 years the new lands are divided among the landowners. Furthermore, storms and high water aggrade shores and fill up sheltered bays and inlets. Channels used by boats and spawning fish are kept open by dredging as long as possible, but eventually they can be used only at high sea level, and finally they are transformed into lakes, marshes, or meadows.

Emergence and aggradation thus combine to cause a continuous and rather rapid transformation of the natural landscape, perhaps unparalleled in the world. By studying successive maps of the region this transformation can be followed in detail.

The oldest maps (Fig. 2) show a very different skerry guard from that of today, owing partly, of course, to the map makers' deficient knowledge of the archipelago but mainly to the greater depression of the land in earlier times.

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REPLÖT and BJÖRKÖBY COMMUNES

Based on the 1942 airphotographic map, scale 1:200 000

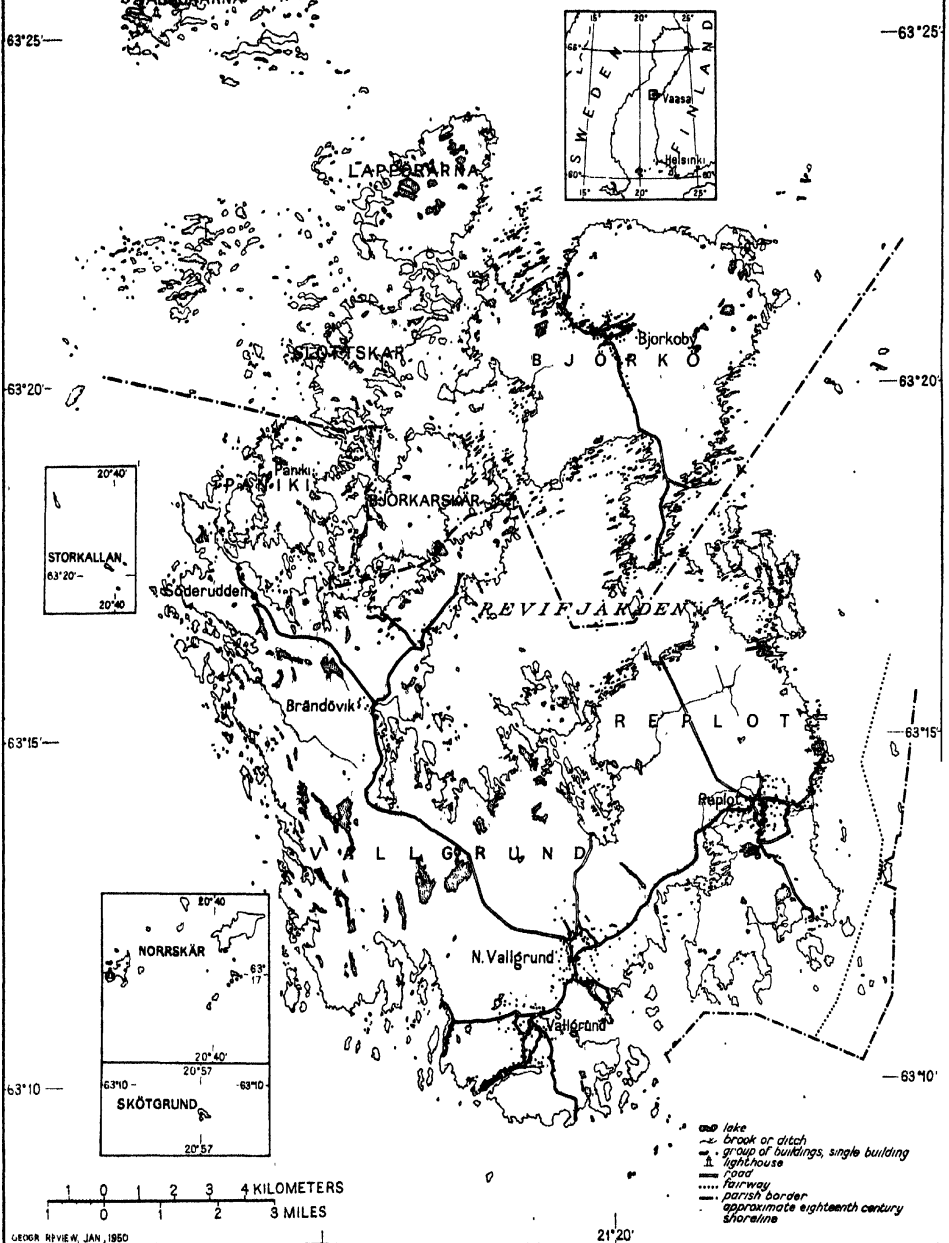


FIG. 1.—Location map of Replot and Björköby communes. Scale approximately 1 : 180,000. Drawn from the author's original map on the scale of 1 : 20,000. Cost unfortunately prevented the reproduction of this fine piece of work, but photostat copies to half scale can be obtained from the American Geographical Society (\$2.40). The map was based on the aerial photographic survey by the Finnish Air Force in 1942. It shows vegetation and land use and cultural features, isobaths in critical areas, and the approximate shore line in the eighteenth century.

On the inset showing the general location of the archipelago the Finnish spellings Vaasa and Helsinki have been used; the author prefers the Swedish forms, which are used in the text.—EDRI. NORR.

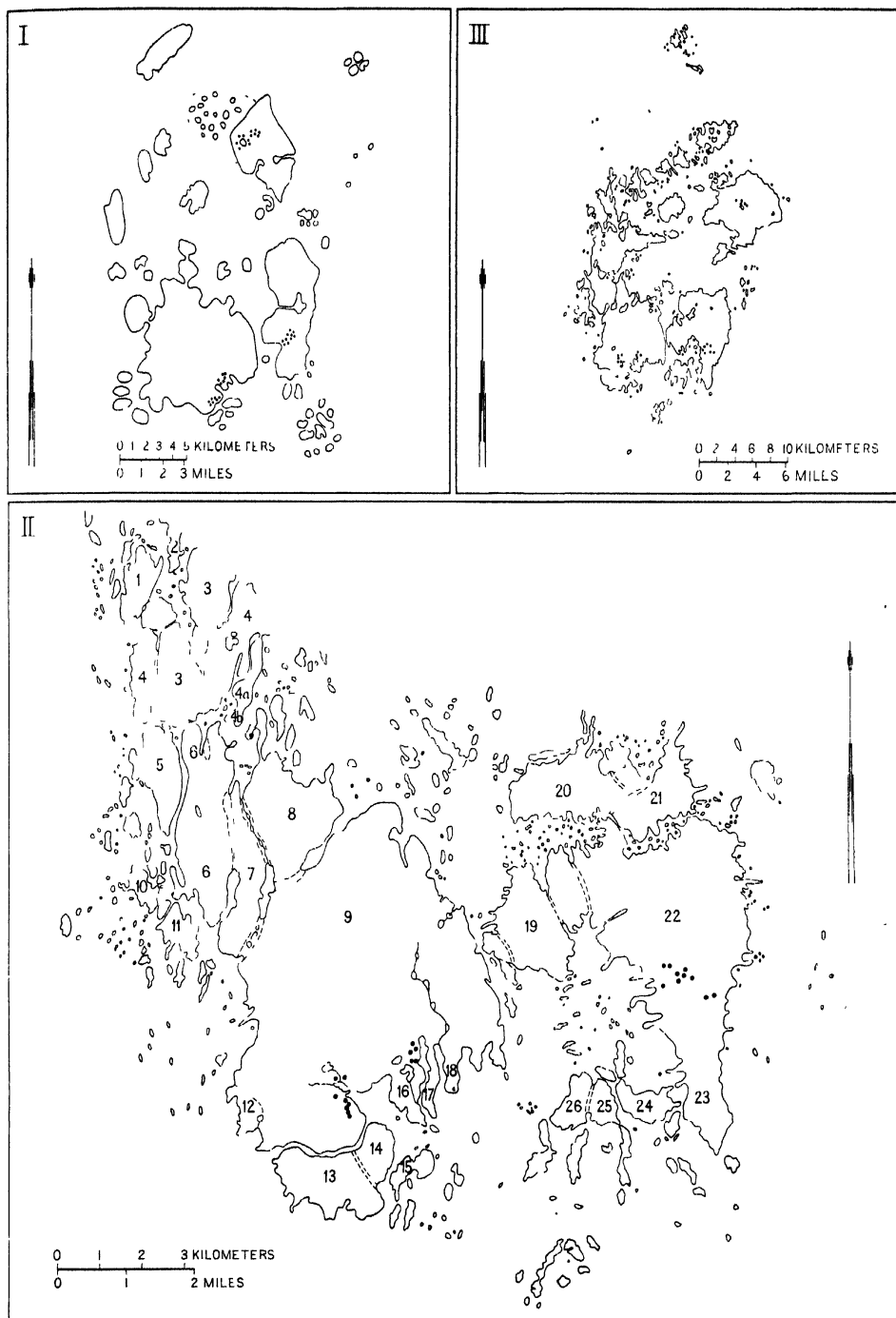


FIG. 2—The Replot skerry guard on old maps. I, On Clas Clason's map of South Ostrobothnia, 1651. Scale of original map 1 : 150,000. II, On an undated map of Mustasari Parish, probably about the middle of the eighteenth century. Black dots, settlements; islands numbered. Scale of original map 1 : 50,000. III, On an undated map of South Ostrobothnia, probably the end of the eighteenth century. Scale of original map 1 : 240,000. I and II are from the map collections of the Finnish State Archives (Court of Records, Helsingfors), III from the Military Archives, Stockholm.

The islands were smaller than at present, the sounds separating them much larger.

The first reliable large-scale mapping was done in 1759-1760 by Jonas Cajanus, surveying for the general redistribution of lands (the *storskifte*), and in Figure 1 the approximate position of the shore line as mapped by him is shown in its relation to the present-day shore line as generalized from aerial photographs taken in 1942. Planimetric measurement of the two maps gives the following figures for land areas, including lakes, in 1760 and in 1942:

	AREA, IN SQ. KM.		INCREASE, 1760-1942	
	1760*	1942	In sq. km.	%
Replot	32.1	43.9	11.8	36.8
Vallgrund	75.4	100.5	25.1	33.2
Björkö	31.5	42.8	11.3	36.0
Björkarskär	5.3	7.0	1.7	32.1
Slottskär	4.3	6.2	1.9	44.2
Paniki	5.1	6.9	1.8	35.3
Lappöarna	7.4	8.6	1.2	17.6
Remaining islands	15.6	22.6	7.0	47.4
Total area	176.7	238.5	61.8	35.0

*The figures for 1760 relate to all the islands that later, by the emerging of the sea bottom (and the drying up of the channel between Replot and Vallgrund), were connected to form the islands listed.

It should be remembered that the position of sea level (see below, p. 116) at the time of mapping governed the position of the mapped shore line and, consequently, the area of the islands. The actual sea level during the 1759-1760 mapping is, of course, not known, but during the 1942 aerial mapping it was 9 to 1.1 centimeters above mean sea level.

Since increase of land by emergence is primarily dependent on steepness of slope, it is natural that the smallest percentages of increase should have occurred in the higher and rougher western part of the archipelago, especially in Lappöarna, with its generally steep shores.

The three large islands still remaining in 1760 are now only two. The channel between Replot and Vallgrund must have dried up about a century ago; for a map based on a survey made in 1867 in connection with the parceling out of new lands in North Vallgrund shows a broad land bridge over the sound. In recent years the entrances to the great central bay have dried up rapidly. Fifty years from now the northern entrances may be dry at low water, and within a century the bay will have turned into a great fresh-water lake.

SURFACE FEATURES

The bedrock, composed of granite and gneiss, is worn down to a smooth surface with the local relief seldom exceeding 10 meters. A somewhat rougher topography is found in Lappörarna and on the west coast of Vallgrund where the author's measurements showed the highest point of the northwestern promontory to be 14.35 meters above sea level. These bedrock irregularities are in part erosional, but they cannot be entirely so; for it would then be difficult to explain why an archipelago has been originated here and nowhere else on the coast of the Gulf of Bothnia. Fractures and displacements of the bedrock, probably Tertiary in age but perhaps initiated in Archean time, and now hidden under the loose deposits, are therefore thought to have caused the more distinct parts of this insignificant relief. In general the islands and the sea bottom are mantled with bouldery moraine and postglacial deposits, which together constitute the most outstanding surface features of the Replot skerry guard.

Frequent striae on rock outcrops in the northwest show that in its latest phase the thinning ice stream moved from north-northeast to south-southwest, following the depression of the Gulf of Bothnia. However, two trends in the morainic topography reveal that the main direction of movement was from north-northwest to south-southeast. Drumlinlike features trending in this direction are clearly distinguishable in the west (Fig. 28). In the east, and especially in the northeast, these features are confused, though even here a few longitudinal morainic ridges can be discerned, as is suggested by the pointed promontories on the north shore of Replot and the south shore of Björkö. Transverse to the direction of ice movement are ridges of recessional moraine. These are probably not annual end moraines deposited during the winter stillstand of the ice, as was formerly believed, but mark the successive positions of an ice front shifting frequently by calving.¹ The annual retreat of the ice margin here is estimated at about 500 meters, whereas the morainic ridges are more closely spaced, often at distances of less than 100 meters.

The resulting washboard pattern of the topography, best developed in the east-central and northeastern parts of the skerry guard, is reflected in the cultural landscape. The low transverse ridges, forest-clad or dotted with settlement, stand out distinctly. The intervening depressions are marked by cultivated fields, lakes, marshes, swamps, or meadows (Figs. 26-28). The

¹ This explanation was first advanced by Gunnar Hoppe in a recent discussion of a similar washboard moraine pattern in northern Sweden (*Isrecessionen från Norrbottens kustland*, *Geographica*, No. 20, 1948, pp. 14-41; English summary, pp. 104-107).

configuration of the shore line is closely determined by the pattern of the glacial drift (note the western and eastern shores of Björkö and the eastern shore of Replot as shown in Figure 1), a matter of great significance for the islanders in their search for harbors and fishing grounds. In the waters surrounding Björkö the smaller islands and the submarine shallows show the same trend. The great central bay of the skerry guard is named Revifjärden, the Reef Bay, because of its multitude of submarine and supramarine reefs, corresponding to the morainic ridges.

CLIMATE AND VEGETATION

The climate belongs to Köppen's Dfc type, having cold snowy winters, short cool summers, and an annual temperature range of about 20° C. At the meteorological station at Vasa mean monthly temperatures for the 30-year period 1901-1930 ranged from -6.6° C. (February) to 13.8° C. (July). The region lies near the border of Köppen's Cfb and Dfb types, and individual years occur with weather conditions similar to these climates. Contrasts result chiefly from the differences in mean winter temperatures, which may vary by as much as 10° C., owing to alternating influences of cold continental and warm oceanic air masses. Mean summer temperatures are less variable, and the mean annual temperature varies even less—from 1.6° C. (1942) to 5.7° C. (1934).

A comparison (Fig. 3) of the mean monthly temperatures at Vasa for the periods 1901-1930 and 1931-1948 (the year 1940 is omitted because the records for January, February, and March are lacking) gives clear evidence of the amelioration of climate observed everywhere in the high latitudes of the Northern Hemisphere. The summer especially has grown warmer. The mean temperatures of May, June, July, and August are now respectively 3.6° , 4.0° , 3.0° , and 2.1° higher than the mean temperatures of these months in 1901-1930. The shortness of the period 1931-1948 should, of course, be taken into account.

Meteorological records at the smaller weather stations at Valsörarna and Norrskär ($63^{\circ} 17' N.$, $20^{\circ} 40' E.$) show that the outer archipelago has a more marine climate than the mainland (Fig. 3). Fall and winter are often several degrees warmer than at Vasa, spring and early summer several degrees cooler.

The precipitation is moderate, and fairly well distributed over the year, with the maximum in summer and fall (Fig. 4). At Vasa the mean annual precipitation for the period 1901-1930 was 598 millimeters; February, March, and April together received only 17.6 per cent of the total, July,

August, and September 33.6 per cent. The outer archipelago is drier, and the contrast between the seasons is more marked. At Valsörarna the mean annual precipitation (1901-1930) was only 484 millimeters, 14.1 per cent of which fell in February, March, and April, 36.9 per cent in August, September, and October (note delay of the maximum). For the period 1931-1948 (year 1940 omitted) the mean annual precipitation was somewhat less—

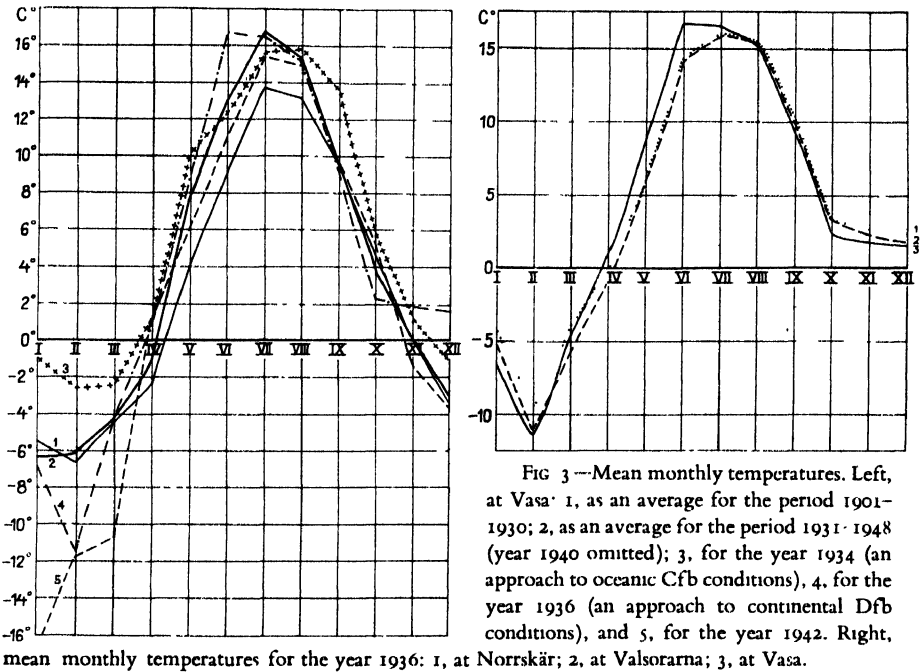


FIG 3 —Mean monthly temperatures. Left, at Vasa: 1, as an average for the period 1901-1930; 2, as an average for the period 1931-1948 (year 1940 omitted); 3, for the year 1934 (an approach to oceanic Cfb conditions), 4, for the year 1936 (an approach to continental Dfb conditions), and 5, for the year 1942. Right, mean monthly temperatures for the year 1936: 1, at Norrskär; 2, at Valsörarna; 3, at Vasa.

only 488 millimeters at Vasa and 408 millimeters at Valsörarna—and, more important, showed a displacement of the maximum toward fall. Fall is now relatively but not actually wetter than formerly, spring relatively and actually drier.

Winds from the southwest and south are commonest in the skerry guard. In midwinter, however, the prevailing westerlies are replaced by north, northeast, or southeast winds of greater velocity from the continental high-pressure center.

The most outstanding climatic features are doubtless the snowy winters and the icebound sea. About two-fifths of the precipitation falls as snow and sleet, but as a result of melting and evaporation the water remaining in the snow cover in the spring represents only a little more than a fifth of the yearly precipitation. The first snow falls in October, the last in early May,

and from the end of November to mid-April the ground is usually covered with snow, which reaches a maximum depth of half a meter in March. However, snow conditions vary considerably from year to year, almost snow-free winters alternating with winters when the snow cover lasts more than six months. For land transport the latter are always considered preferable, since then the islander can use the shortest ways over meadows, swamps, and fields that are untrafficable in summer.

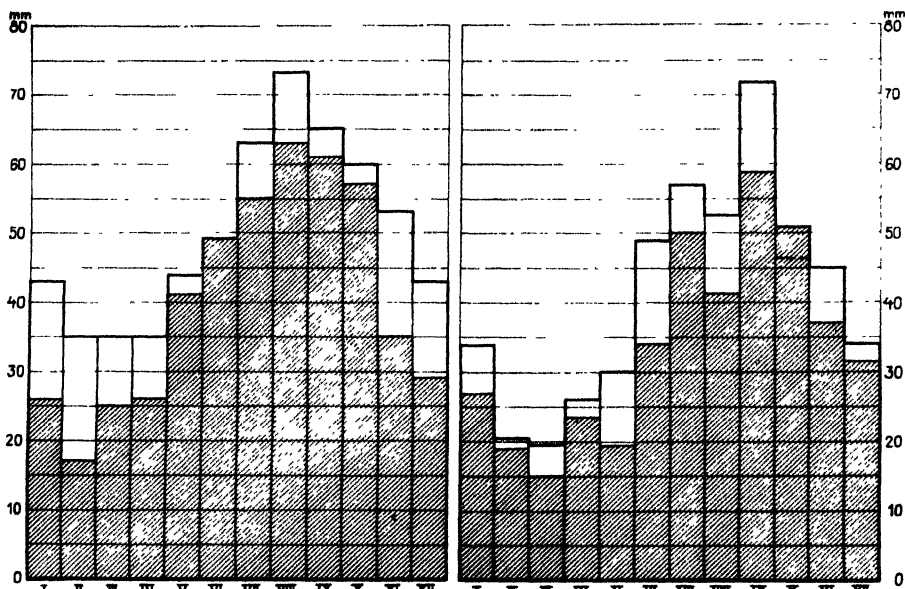


FIG. 4—Mean monthly precipitation for the periods 1901-1930 and 1931-1948 (shaded; year 1940 omitted) at Vasa (left) and Valsörarna (right).

Almost the whole land area is covered with forest. The barren zone characteristic of the outer skerry guard in southern Finland is restricted to the outermost islands (Norrsjär, Skötgrund, Storkallegrund, west of the islands shown in Figure 1), part of the Valsörarna archipelago (Fig. 22), and a few more centrally located islands where the soil is very thin or entirely lacking.

Conifers, especially Norway spruce, dominate over deciduous trees, increasingly so as the islands emerge. This is thought to be caused largely by sinking of the ground-water level as the land rises, but extensive sheep pasturing also plays a role. It is curious how many islands still bearing names such as Alskär, Algrund, Björkö, and Björkskär (*al*, alder; *björk*, birch) are now poor in alder or birch. On the other hand, an island or a tract named Furuskär or Tallholm (*fura* and *tall*, pine) always carries pine forests, since

they are edaphically determined. On the large islands the succession of natural vegetation from the shore inward is: (1) alder groves, often with dense ground vegetation of grass and herbaceous plants; (2) dense spruce forest with ground vegetation of *Vaccinium* (on drier soil red whortleberry, *V. vitis-idaea*; on moister soil blueberry, *V. myrtillus*); (3) thin spruce, pine, or birch forest with ground vegetation of red whortleberry, crawberry, heather, or lichens. Type 1 covers the small islands entirely and on the larger islands forms a border along bays, wide or narrow according to the degree of slope and practically absent on exposed promontories and steep shores. It has been of importance in the pastoral economy of the islands. Type 2, the spruce forest, covers the inner part of the fairly large islands and almost the entire area of the large islands. Especially on low, even terrain near the shore it grows luxuriantly. It is the basis of the forest industry of the islands. Type 3 is commonest on high islands such as Paniki and Lappöarna.

When the sea bottom emerges, the deeper depressions as a rule are gradually overgrown by mosses and sedges and turned into swamps and bogs. Old bays, sounds, and inlets can thus be clearly discerned centuries after their rise above sea level. True peat bogs are found in the heart of the larger islands. The marshes and swamps have furnished grazing lands of the utmost importance to the pastoral economy, and their silt or clay soils offer the best opportunity for present-day land reclamation for agriculture.

THE SEA

The waters of the North Kvark, more than a thousand kilometers from the ocean, are shallow, brackish, and nearly tideless. The salinity of the surface water is 4.5 per thousand south of the skerry guard, 3.5 per thousand north of it. Bottom water is slightly saltier, except near the beginning of October (Fig. 5). Then equilibrium is attained, and from the bottom to the surface the water has a salinity of about 4.25 per thousand. At the shore the salinity sometimes falls to 2 per thousand, in the spring because of the influx of fresh water from melting snow, in late summer because of the heavier rains. If necessary, such water can be used for drinking and cooking; it is always used at the summer fishing stations or on the long seal-hunting expeditions. The surface water reaches its highest temperature in August, the bottom water in September or October. The difference between warm surface water and cold bottom water is most marked in July and August (Fig. 6).

The presence of layers differing in salinity and temperature has a profound bearing on the movements of fish shoals. Another factor influencing

the life of the sea is the influx, during the spring thaw, of nitrogenous and phosphoric matter, which furnishes summer food for the plankton.

The freezing of the sea markedly affects the rhythm of island life. When it is frozen solid, new ways of transport are possible, with new opportunities for fishing and hunting and for communication between islands and with the mainland. On the other hand, the slow freezing of the shore waters

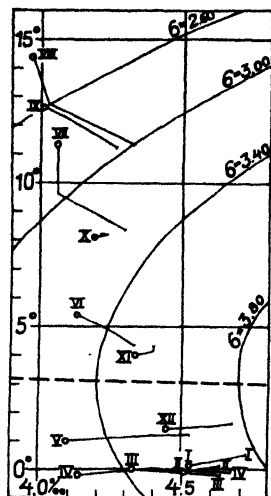


FIG. 5

FIG. 5—Temperature and salinity of the sea for the first day of each month at Valsörarna as an average for the period 1921-1930. I-XII, temperature at surface, at 5 meters (hinge), at 10 meters (end of line). The curves are lines of equal density of water; broken line, maximum.

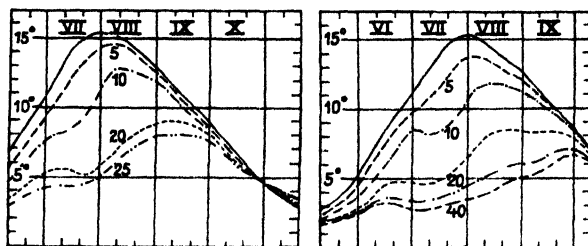


FIG. 6

FIG. 6—Sea temperatures. At left, at Snipan (lightship in the North Kvark) for the period June 10 to November 20, at the surface and at depths of 5, 10, 20, and 25 meters. At right, at Norrskär for the period June 10 to October 10, at the surface and at depths of 5, 10, 20, 30, and 40 meters. After Gunnar Granqvist: *Zur Kenntnis der Temperatur und des Salzgehaltes des Baltischen Meeres an den Küsten Finnlands, Helsingfors, 1938.*

in the fall isolates the skerry guard from the mainland for several weeks, and the thinning of the ice in the spring has the same effect, though usually for a shorter period. During those weeks when the sea carries neither boat nor sledge there are good opportunities, never neglected by the islanders, for fishing, though at the cost of many lives, as the parish register of drownings testifies.

The duration of the ice cover varies from year to year. In normal years solid ice extends over Revifjärden and the inshore waters for 26 weeks, over the offshore waters for 20 weeks, over the waters surrounding Valsörarna for 14 weeks, and over the waters surrounding Norrskär for 10 weeks. In mild winters the corresponding periods are 20, 12, 9, and 3 weeks, in severe winters 29, 26, 22, and 17 weeks. In normal years the ice cover begins to form in early November, and about a month later the islands are connected with the mainland by an ice bridge (Fig. 7). The maximum thickness of more than one meter is not reached until mid-March. Bus service over the

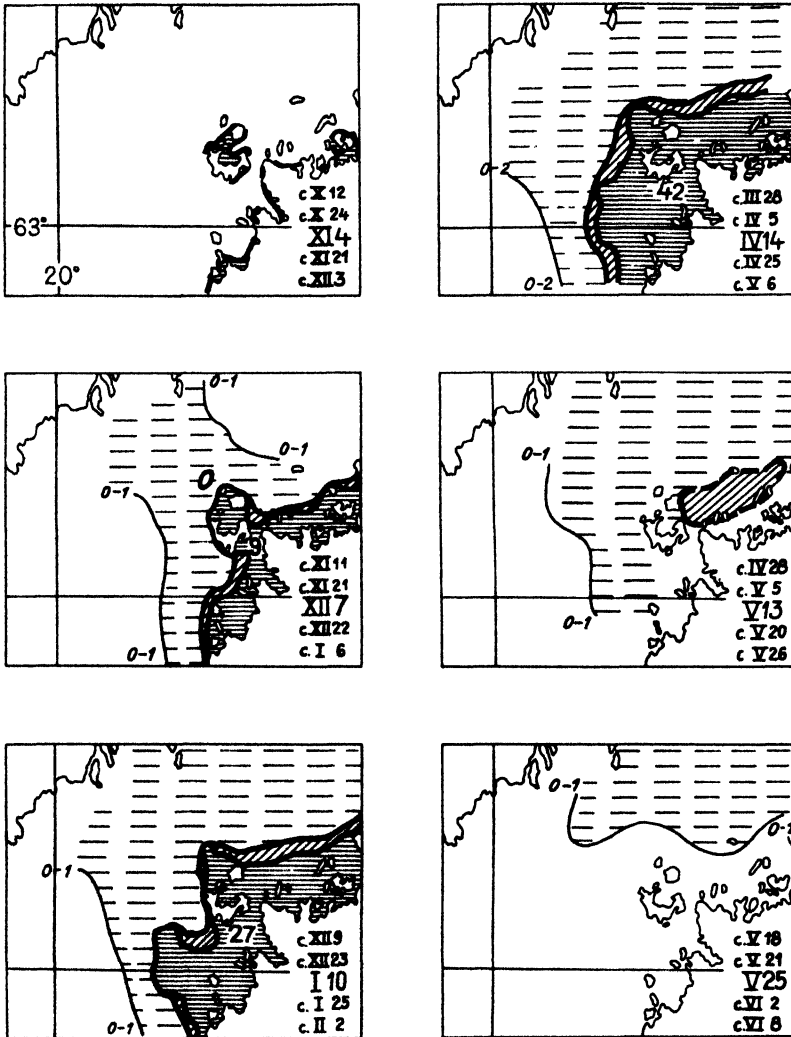


FIG 7—Formation and breakup of ice cover in the North Kvark according to Risto Jurva: über die Eisverhältnisse des Baltischen Meeres an den Küsten Finnlands, nebst einem Atlas, Helsingfors, 1937. Interrupted shading, drift ice; dense shading, solid ice; less dense shading, unreliable solid ice; Arabic numerals, thickness of ice sheets in centimeters. Dates show average occurrence: center, in normal winters; upper, in mild; uppermost, in very mild; lower, in severe; lowermost, in very severe.

ice during the mild winter of 1948–1949 was maintained from March 5 to 26. The North Kvark and Bothnian Bay are also ice-bridged one year in two, but the wider Bothnian Sea is seldom entirely ice-covered and in mild winters is even free from drifting ice. In spring thick layers of pack ice clutter the shores of the outermost islands; small islands may be completely covered. After very severe winters drift ice is found until July.



FIG 8

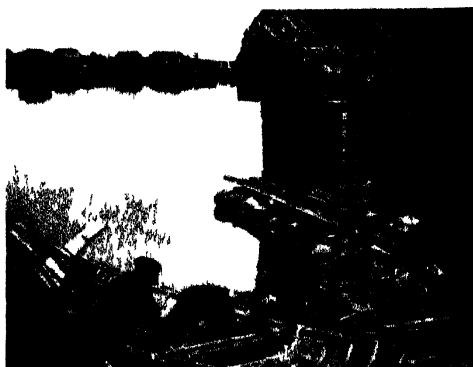


FIG 11



FIG 9

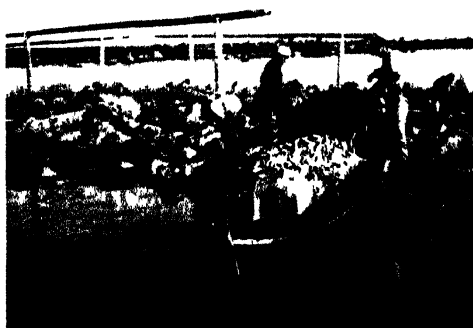


FIG 12



FIG 10



FIG 13

FIG 8—Summer fishing station at Ebbskar, northern Valsorarna (see Fig 22) To the right, sweep nets drying on wooden frames, to the left, flat-sterned rowboat and sailboat (Photograph by Sverre Boucht, Vasa, 1947)

FIG 9—Summer fishing station at Storskar Big pilot boats in foreground Sparse deciduous forest (Sverre Boucht, 1945)

FIG 10—Bodvattnet, main harbor of Bjorkoby Shallowing bay between two morainic ridges, reeds (*Phragmites communis*) in foreground (Sverre Boucht, 1939)

FIG 11—Fishermen fastening sinkers to nets, Bjorkoby harbor Boulders weight thatch of boathouse and rudder is loosened against damage in shallow waters (Sverre Boucht)

FIG 12—Fishermen from Bjorkoby shaking herring loose from nets on one of harbor islands Note drying frames (Sverre Boucht, 1948)

FIG 13—Main harbor of Replot village Older boathouses are at some distance from the water, newer ones built out into the water (Photograph by Lauri Huhtala, Vasa, 1947)



FIG 14



FIG 15

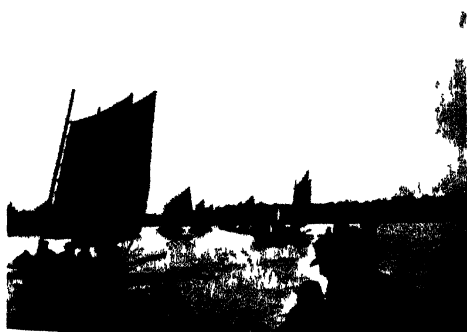


FIG 16

FIG 14 Stony islands, submerged recessional moraines, now being uncovered in Bjorkoby harbor (Sverre Boucht)

FIG 15—Massive stone wall built of boulders from morainic drift Replot village Old-style smoke kiln for meat curing built at a distance from the dwelling to prevent fire (Lauri Huhtala, 1947)

FIG 16—Sheepday, Bjorkoby, 1938 Sheep are brought home by boat from Valsorarna, seen in the background Note typical double spritsails (Sverre Boucht)

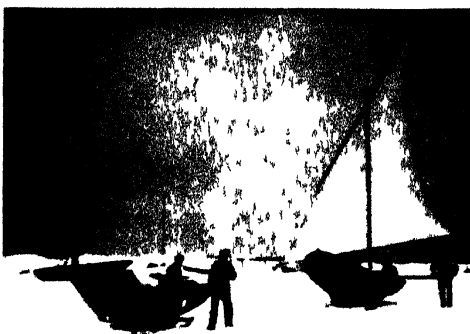


FIG 17



FIG 18



FIG 19

FIG 17— Seal hunter hauling the fal-boat out to the border of the ice with the aid of the lug-sail rowboat on runners (Sverre Boucht, 1930)

FIG 18—Man with his womentolk on the way to the "leaf woods," Bjorkoby The deciduous woods are visited every three years to cut leaves for winter fodder (Sverre Boucht, 1926)

FIG 19—Sheepday, Bjorkoby, 1938 Sheep being driven home from the harbor The men carry canes on which the brand marks are cut (Sverre Boucht)

The most outstanding feature of the waters around the skerry guard is their shallowness, which is accentuated by the frequent fluctuations of sea level and by the huge underwater glacial boulders (Figs. 14, 25). Navigation demands a thorough knowledge of the channels and concentrated attention, especially at low water. Landing is difficult. Few shores can be reached, even with the islanders' flat-sterned boats, and harbor structures are necessary. These consist of parallel stone walls built out into the water and, because of the changing sea level, reaching high up on the shore (Figs. 8, 9, 11, 12, 13).

The fluctuation of sea level caused by ordinary tides is negligible, amounting to not much more than three centimeters. Fluctuations caused by winds, shifting air pressure, rains, and meltwater are ten times that amount, and more. The greatest range between low and high level observed on the marigraph at Vasklot (the outer harbor of Vasa) in the period 1922-1938 was 2.25 meters. The ordinary annual range is smaller, about a meter and a half, from not much more than one meter (1.06 meters in 1926) to almost two meters (1.92 meters in 1929). Normally the maximum occurs in fall (October or November) and the minimum in spring (April or May), but there may be high water in early spring and late summer and low water in winter and early fall. The sea level is most stable during the summer, fluctuations then being usually less than half a meter. During the fall and winter, sea level is highly unstable, fluctuations amounting to a meter or a meter and a half within a month.

Because of frequent short-term fluctuations—often a rise or fall of as much as half a meter overnight—and the gentle slope of the land, the changes in the position of sea level are watched with anxiety. The islander uses several harbors and never forgets to fasten his boat when landing. At night he may rise several times and, if necessary, haul his boat higher up on the shore or move it to a safer harbor. It is scarcely an overstatement that the islander fastens and watches his boat as carefully as the nomad of the desert tethers and cares for his horse.

The fluctuations in sea level influence life on the islands in numerous other ways. They make it necessary to extend fences a long distance out into the sea. In winter they cause breaks in the ice cover, especially around stones rising above the mean sea level, and at the water holes thus created otters, formerly common in the skerry guard, are still caught. When the ice cover is beginning to form, ice floes pushed up on the shore by storms may cause damage to shore structures; so too may a rise of the icebound sea in mid-winter. Harbor walls are often reinforced with huge logs, gathered from ship wreckage.

Low water narrows the range of navigation; high water extends it. High water restores the seafaring conditions of the past, making old channels navigable again and old abandoned harbor sites usable; low water brings into temporary existence the seafaring conditions of the future, closing channels normally in use and making landing difficult at existing harbors. Upwarping of the land gradually makes low-water conditions permanent and compels a repeated shifting of harbor sites. On the shores of the villages all stages in the evolution can be studied. When the retreating sea has reached a level that at normal low water leaves the bottom of the harbor dry, a new harbor site must be found on the nearest steeper slope, usually the nearest leeward side of a morainic ridge. If this is on an island, it is joined to the shore by constructing a bridge of boulders from the moraine (Fig. 22). Only steepish slopes are chosen for harbors, both because the short-term fluctuations in sea level cause a smaller horizontal shift in the shore line and because they can be used for a longer time. But harbor sites must be shifted at intervals of probably 50 years, so that every generation of islanders is affected. Slopes steep enough to make landing possible for a century or more are scarce. The east shore of Replot island is the foremost example; here harbors have been in use for more than two centuries.

POPULATION AND SETTLEMENT

The islands form one parish, divided into two communes, Replot and Björköby. Settlement focuses on four areas: (1) the south-central part of the former island of Replot (Replot village); (2) the southern part of Vallgrund (North and South Vallgrund villages); (3) the eastern shore of the great northwestern promontory (Brändövik and Söderudden); and (4) the west-central part of Björkö (Björköby village). The first, second, and fourth are old, relatively agglomerated settlements that were already in existence at the time of the earliest historical records, which date from the end of the fifteenth century. In the third area settlement, begun at the end of the eighteenth century, is still thin and scattered.

Scattered archeological finds prove that the archipelago was visited by man, and may even have been inhabited, a thousand years ago. The present population is entirely of Swedish stock. Local names are Swedish, but in the neighborhood of the villages frequent place names beginning with *Finn-* indicate a settlement, permanent or temporary, at the time of the arrival of the Swedish colonists. It is probable that the name "Finn" in those early days, as today in Sweden, was applied to an inhabitant of Finland without regard to nationality. Certain facts seem to prove that the supposedly

Finnish settlement in Vallgrund originated from Boddeby in Laihela, a center of earlier Swedish settlement on the mainland. Earlier indications, however, for instance the Finnish name of one of the old farms in Replot village (Lassila), show that a true Finnish settlement was in existence in the archipelago when the Swedish colonists arrived.

There are 604 permanently occupied habitations, of which 144 are in Replot, 241 in the Vallgrund villages, 69 in Brändövik-Söderudden, and 150 in Björköby. According to the tax register of January 1, 1941, the distribution of population is: Replot, 875 (31.4 per cent of the total population, 2789); Vallgrund villages, 1021 (36.6 per cent); Brändövik-Söderudden, 298 (10.7 per cent); and Björköby, 595 (21.3 per cent). The average number of residents per habitation is thus 6.0, 4.2, 4.3, and 4.0. The dwellings, large wooden log houses often painted red, are conspicuous in comparison with the tiny barns, stables, and storehouses, a sign of the unimportance of agriculture. Dwellings are built on foundations of rectangular stones, hewn out of local granite, mostly from glacial erratics, and boathouses are placed on rounded glacial boulders.

In addition to the permanent settlements, there are simple wooden huts erected on the smaller islands and inhabited during the fishing season. Many are now in decay, because fishing with motor-driven boats has made some of them superfluous and because the interest of the landowners is turning toward agriculture. On the barren outermost islands, however, they are usually still conspicuous (Figs. 8, 9, 22), rising above the horizon before the island itself can be discerned. For protection against high water and ice pressure they are often erected in the very center of the islets. The timber must be transported from the home islands, and this is usually done in winter, over the frozen sea. The more solidly constructed dwellings of pilots and lighthouse keepers in the outer archipelago are inhabited by the whole family during the fine season; in winter only some of the men remain. A small number of summer resorts are also found in the skerry guard.

In the selection of sites for settlement, nearness to a sheltered harbor has played the primary role. Today, however, this type of site is not easily discerned, since old harbors have dried up and the growth and spread of settlement have confused the original pattern. Some harbor sites, however, are still conspicuous (Figs. 26, 27). Because of the scarcity of arable land, the houses are as a rule placed on the stony morainic ridges, which have eventually become fully occupied (Figs. 20, 21). Nearer the present shore line are the dwellings of the landless population, erected on common land set aside when the land divisions were made. Especially in Replot and South Vallgrund they form a striking feature in the cultural landscape (Fig. 27).

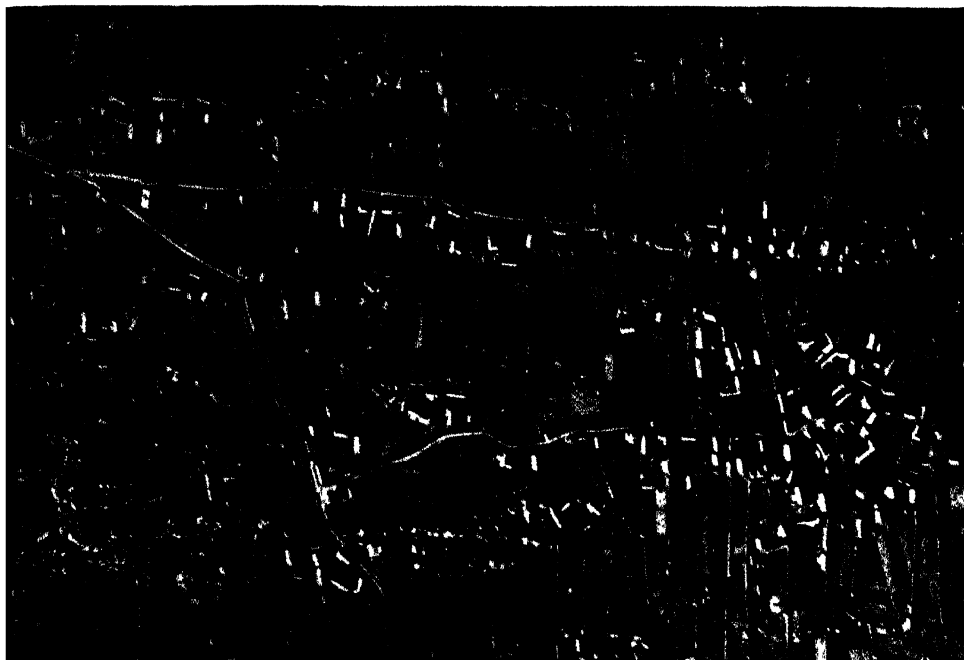


FIG. 20—Björköby village (top of photograph north-northwest). Note the houses strung along the morainic ridges and the multitude of stone-wall fences cleared from the glacial drift. (Finnish Air Force, Sept., 1942.)

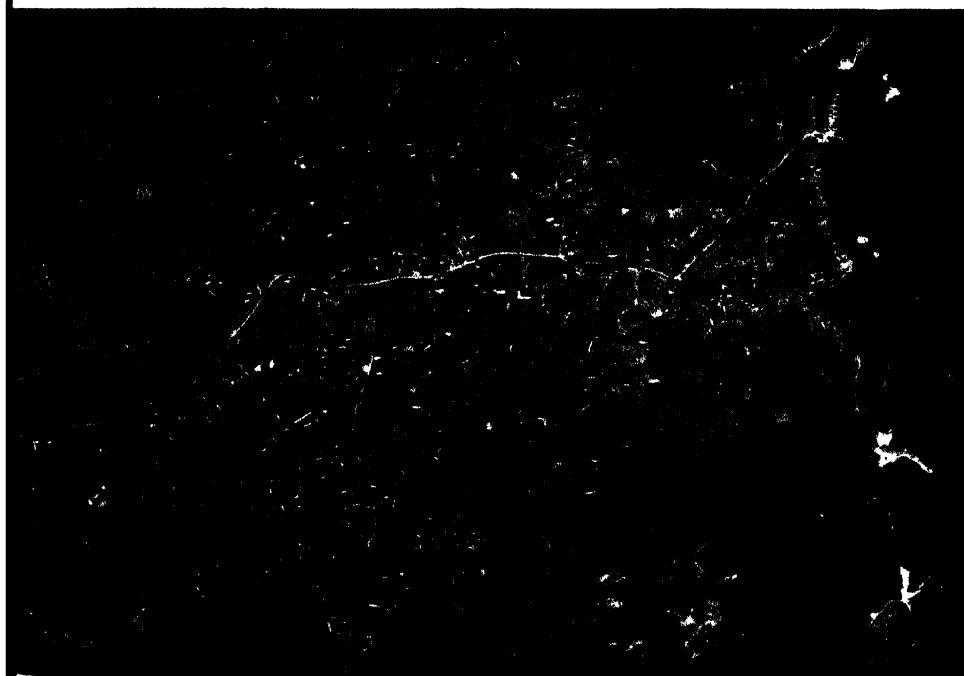


FIG. 21—Replot village (top of photograph north). The center of the settlement is on a recessional morainic ridge. The black squares mark eighteenth-century dwelling sites. The old harbor site is in the bottom left-hand corner of the photograph. (Finnish Air Force, Sept., 1942.)

THE ECONOMY

Official statistics show that in 1940 the working population was distributed among the following occupations: agriculture and accessory trades, 71.2 per cent; manufacturing and handicrafts, 15.6 per cent; transportation, 5.1 per cent; public services, 4.4 per cent; commerce, 0.6 per cent; miscellaneous trades, 1.3 per cent. Those without specific occupation made up 1.8 per cent of the total. In earlier statistics the agricultural workers were divided into farmers and fishermen, the latter group being somewhat the smaller. Statistics of the fishing industry in 1934 show 22.8 per cent of the population entirely dependent on fisheries and 28.7 per cent partly dependent. In Björköby commune the figures were 18.5 and 51.3 per cent respectively, and in Replot commune 23.8 and 22.2 per cent.

A still clearer idea of the economic situation on the islands is afforded by the agricultural statistics of 1941, which give the distribution of the population on farms of different sizes. The figures, expressed in percentages of the total 1940 population, are as follows:

<i>Hectares</i>	<i>0.25</i>	<i>0.25-0.5</i>	<i>0.5-1</i>	<i>1-2</i>	<i>2-3</i>	<i>3-5</i>	<i>5-10</i>	<i>10-15</i>	
Björköby commune	3.8	3.4	15.2	15.7	17.1	18.4	14.3	1.2	10.9
Replot commune	6.6	4.7	14.0	16.3	15.8	18.4	11.8	0.3	12.1
Skerry guard	6.0	4.4	14.3	16.2	16.1	18.4	12.3	0.5	11.8

*This column, computed by the author, represents the nonfarming and landless population of the archipelago.

Since a skerry farm may be defined as a holding including three hectares or more of arable land, these figures show that barely a third (31.2 per cent) of the population of the skerry guard can be ranked as farmers, the ratio being a little greater (33.9 per cent) for Björköby, a little smaller (30.5 per cent) for Replot. Thus more than two-thirds make their living mainly in industries other than agriculture. The nonfarming population is largest in Söderudden and the neighboring settlements; South Vallgrund village follows, and then North Vallgrund-Brändövik. Björköby and Replot villages, in contrast, are largely farming communities.

FISHING AND SEAL HUNTING

Fishing and seal hunting were, in the early days, the main occupations in the skerry guard. Of the fishing harbors named in the fish tax registers of the sixteenth century some of the most important in the country were in the Replot archipelago. As settlement grew denser, however, in the

eighteenth and nineteenth centuries, the catches diminished. Old fishing grounds were drying up, and at the shallow spawning grounds overcatching of spawning fish was leading to depletion. Interest turned more and more toward the deeper offshore waters.

The fishing statistics of Finland are not very reliable. In 1934, however, a more careful reckoning than usual was carried out. The catch in Replot and Björköby communes together amounted to the following: Baltic herring, 343,000 kilograms; whitefish, 46,700; perch, 45,900; pike, 38,600; burbot, 38,000; salmon, 3700; other fish, 18,600. Of this total catch of 534,500 kilograms, only 80,400 kilograms came from Björköby commune.

In summer, and until the beginning of stormy fall weather, fishing is carried on in the outer skerries. In winter, when fish are caught through holes in the ice, and in spring, which is the busiest fishing season, the waters nearer the main islands are the fishing areas. Herring is caught in greatest amount, and in spring, and sometimes in summer, it brings fierce activity to the fishing harbors. The nets are pulled up early in the morning and brought to the shore, where the herring are shaken from them (Fig. 12), a job that may take hours if the catch has been abundant. Formerly the herring were cleaned, salted, and packed in wooden boxes at the local harbors. In recent times, however, the main part of the catch is marketed fresh to buyers on the islands, to fish-curing factories at Björköby, South Vallgrund, and Söderudden (erected early in the twentieth century), or directly to the Vasa city market. From the more distant stations—for example, Norrskär, the most important herring harbor—the journey to market and back by motor-driven boat may take as much as 10 hours. The seasonality of the herring market and the perishableness of the catch result in marked instability of price, and it is no wonder therefore that the islanders turn more and more from this hard work to other occupations.

Verk fishing, of great importance in the early days, has lost its old significance. It is based on the construction of fish verks—stone walls often as much as 100 meters long—from each side of an inlet to narrow the channel. The fish are caught in bow nets with a wooden frame fitted in the opening. The entrance is turned toward the sea in spring, when the fish move in toward fresh water, and toward the land in fall, when they move seaward. Of more than a hundred fish verks found on the islands only a few are now in use. The others have been abandoned because of the drying up of embayments, overfishing, and changing consumption habits—ide, roach, and seip, which formed the main catch, are not now used as human food.

In the outer archipelago fishermen, pilots, and lighthouse keepers watch

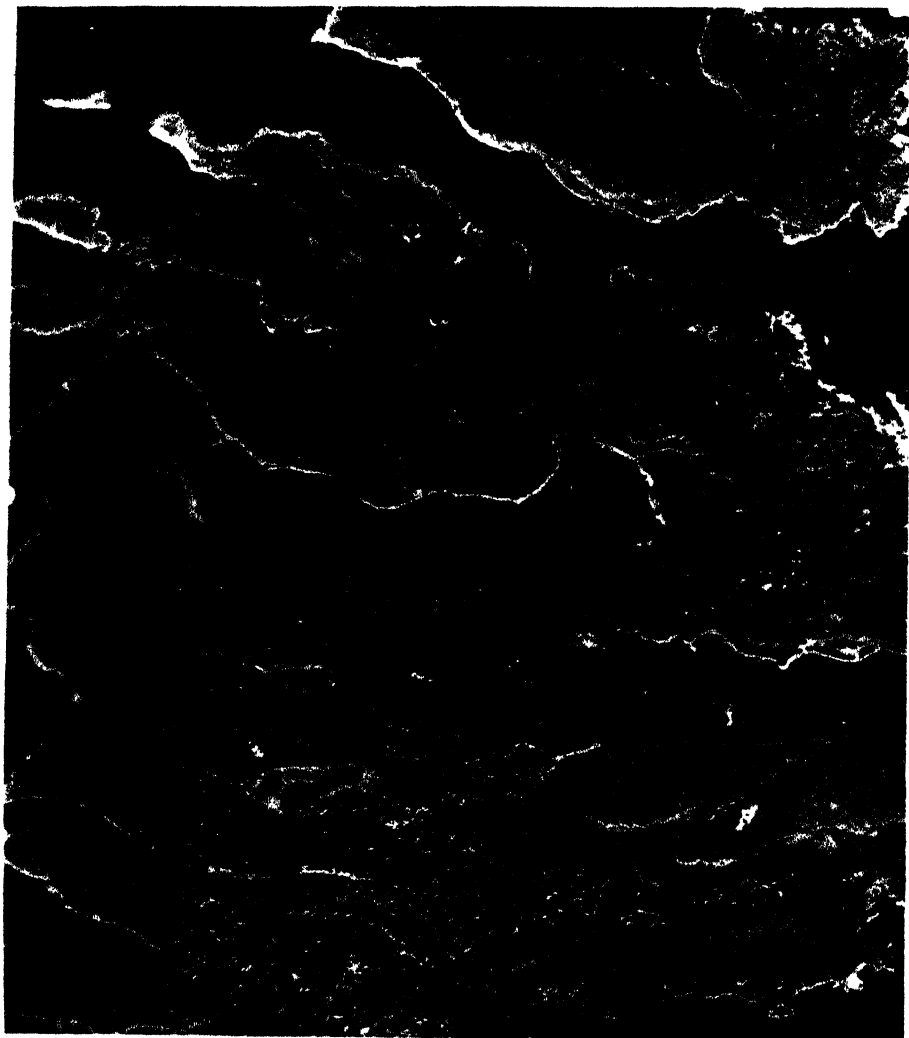


FIG. 22—Barren outer skerries of northwestern Valsörarna (top of photograph north). Thin fringe of alder and willow along the shores; thin deciduous forest in the south. Summer fishing settlements are discernible near the top of the photograph (Ebbeskär, see also Fig. 8) and at the bottom (Norra Storören). Note the stone bridge between Storskär and Ebbeskär built at the end of the nineteenth century. (Finnish Air Force, Sept., 1942.)

In looking at vertical aerial photographs there is often a tendency to invert the relief. This is perhaps due to a convention related to plastic models or maps with hill shading, namely the assumption that one is looking north and that when the light in the photograph casts shadows away from, and to the right of, the observer it is coming from the northwest and casting shadows to the southeast. To anyone conditioned by this convention, mounds may appear as holes and vice versa.

To overcome this difficulty, the photograph can, of course, be reoriented. Sometimes, however, it is desirable in studying groups of photographs to view them consistently as from south to north. Under these circumstances the exercise of a little will power and concentration on firmly keeping in mind the direction of the light source will usually overcome this difficulty of interpretation.—EDIT. NOTE.

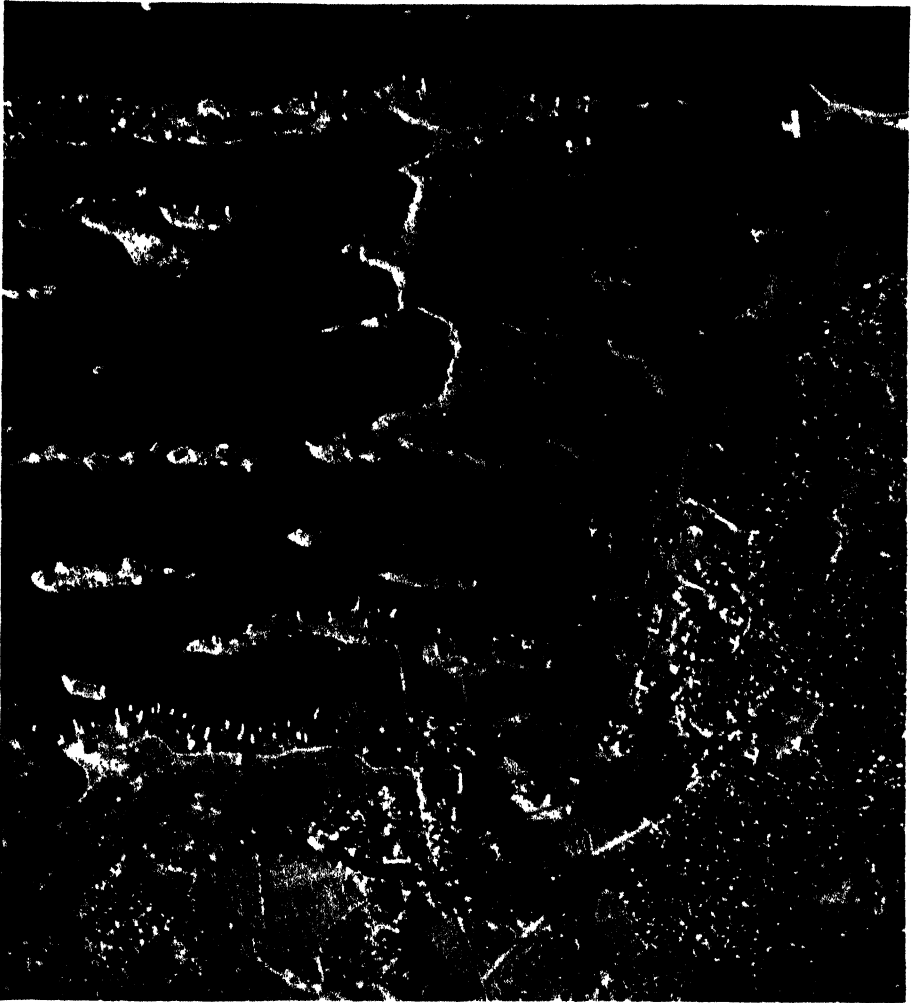


FIG. 23—The main harbor of Björköby, northwest of the village (top of photograph north-north-west). Adaptation to the recessional moraine pattern stands out, and also changes (shiftings of harbor sites) caused by emergence of the land. In the top right-hand corner is a fish-curing factory. (Finnish Air Force, Sept., 1942.)

the sea from towers erected at the fishing harbors (Fig. 8) and now and then get a seal. However, this accounts for only 10 to 20 per cent of the seals killed by the islanders. The main catch is still taken on long hunting expeditions, or *fälas* (*fäla=färd*, journey), on the frozen Gulf of Bothnia, chiefly in Bothnian Bay.

The two species of seal living in the Gulf of Bothnia, the larger gray seal, *Halichoerus grypus* (length, about 200 centimeters; weight, as much as 170 kilograms), and the smaller bay seal, *Phoca foetida* (length, about 150

centimeters; weight, 50 to 60 kilograms), are hunted when they get up on the ice to litter, the former usually at the end of February, the latter at the end of March. Since they remain there with the cubs for several weeks, the seal-hunting expeditions start in March or even in April. The fäl-boats are put on sledges and pulled to fishing harbors in the outer archipelago (Fig. 17). Here the crews, four or five men to every boat, stay for some days, watching for open water. When the advance into the ice is free, the fäl-boats spread out in search of suitable "seal ice," often large floes, where a camp is pitched. From it the hunting goes on as long as seals can be caught or until the breaking up of the drifting ice floe makes removal necessary. Gray seals gather in crowds that may number thousands and do not regularly keep holes open in the ice, whereas bay seals live in couples and always keep holes open, to which they betake themselves when alarmed by the incautious approach of a hunter or when not killed by the first shot. The gray seals are therefore more easily caught, and hunting is often a mass slaughtering, performed with the ice chisel. The shy bay seals are always killed by shooting. The marksman wearing a white shooting dress approaches the seal lying on a 14-foot-long ski on the fore end of which a white cloth has been put up as a blind. In recent times rifles with telescopic sight have come into use.

Often, when crevices open in the ice, hunters are separated from the fäl-boat for several days and may perish if they do not succeed in reaching the coast. If the fäl-boat is caught in the ice or is forced against the ice border in full cargo in a high sea, the whole crew may go down. The return journey in heavily loaded boats is especially dangerous, and often the catch, or part of it, has to be sacrificed to save the crew. "Drowned in the seal ice" and "vanished in the fäla" are common remarks in the parish register.

In severe winters the gray seals litter in the southern part of the Bothnian Sea. It is therefore in mild winters, when they are forced to turn northward in search of ice for littering, that the catch is greatest. The years 1913, 1921, 1925, and 1930, in which large numbers of seals were killed (4871, 2620, 3213, and 2447 respectively), had mild winters (means January to April: -2.3°C. , -1.6° , -1.3° , and -0.8° respectively). On the other hand, the years 1926, 1936, and 1937, in which catches were small (791, 784, and 749 seals respectively), had severe winters (means January to April: -5.6°C. , -5.4° , and -3.4° respectively).

The number of fäl-boats has decreased in the past 20 years from more than 20, with a total crew of about 100, to 10 or 12, with a total crew of about 50. The catch, however, has not decreased greatly. During the period 1930-1939 it averaged 1453.7 seals yearly, as compared with 1690.3 seals

during 1920-1929. The average for the period 1910-1916, however, was 2863.1 seals.

AGRICULTURAL ACTIVITIES

The climate of the skerry guard is more suitable for hay than for cereals, and animal husbandry is the chief interest of the farming islanders. In 1947 hay and fodder occupied about three-fourths of the crop area (73.2 per cent in Björköby commune, 79.8 per cent in Replot commune). The rest of the area was divided among rye (respectively 2.3 per cent and 1.3 per cent in the two communes), spring wheat (7.2 per cent, 6.3 per cent), barley (5.1 per cent, 3.6 per cent), oats (7.8 per cent, 5.6 per cent), potatoes (3.5 per cent, 3.1 per cent), and fallow (0.9 per cent, 0.3 per cent). The slightly greater relative importance of grains in Björköby commune reflects both the larger crops of hay gathered from the natural meadows and the greater isolation, which requires larger areas to be reserved for food crops.

Because of the cool spring and the mild fall, both sowing and harvest take place later than on the mainland. Crop failures caused by frost may occur in June and July but are rare in late summer and fall, even when they occur on the mainland. The chief climatic drawback for skerry farming in comparison with that of the mainland is the inadequate and unreliable early summer rainfall. A markedly dry summer with a rainfall of less than 90 millimeters (June-August) is likely to occur at an average interval of four years.

The soil of the skerry guard, derived from the stony moraine, is poor. The first fields were tiny patches in the less boulder-strewn parts of the meadows, and up to the middle of the nineteenth century this patchy pattern largely predominated. However, as a result of increasing population pressure and aided by the redivision of lands, a great era of land reclamation began near the end of the century and continued uninterruptedly during the first three decades of the twentieth century.

The first efforts were directed toward clearing the old meadows on morainic ground near the villages. Here the reclamation work, done after the fall plowing and before the freezing of the ground, has been facilitated by the use of dynamite and of special small, movable stone cranes for removing the boulders pushed up to the surface by frost action. It has been estimated that in Björköby in 1919, from each *kappland*—about one twenty-sixth of an acre—reclaimed, 50 cartloads of boulders had to be cleared. The apparently age-old stone walls around the fields (Fig. 15), now a conspicuous part of the cultural landscape, are thus actually of fairly recent origin. Put together they would probably form a line more than a hundred kilometers long.

As reclamation was slowly extended beyond the old meadow clearings into the forest, the lower and on the whole less stony and more silty areas between the morainic ridges were chosen as new sites for cultivation. As a result, the cultural landscape has tended to develop a streaky pattern, re-

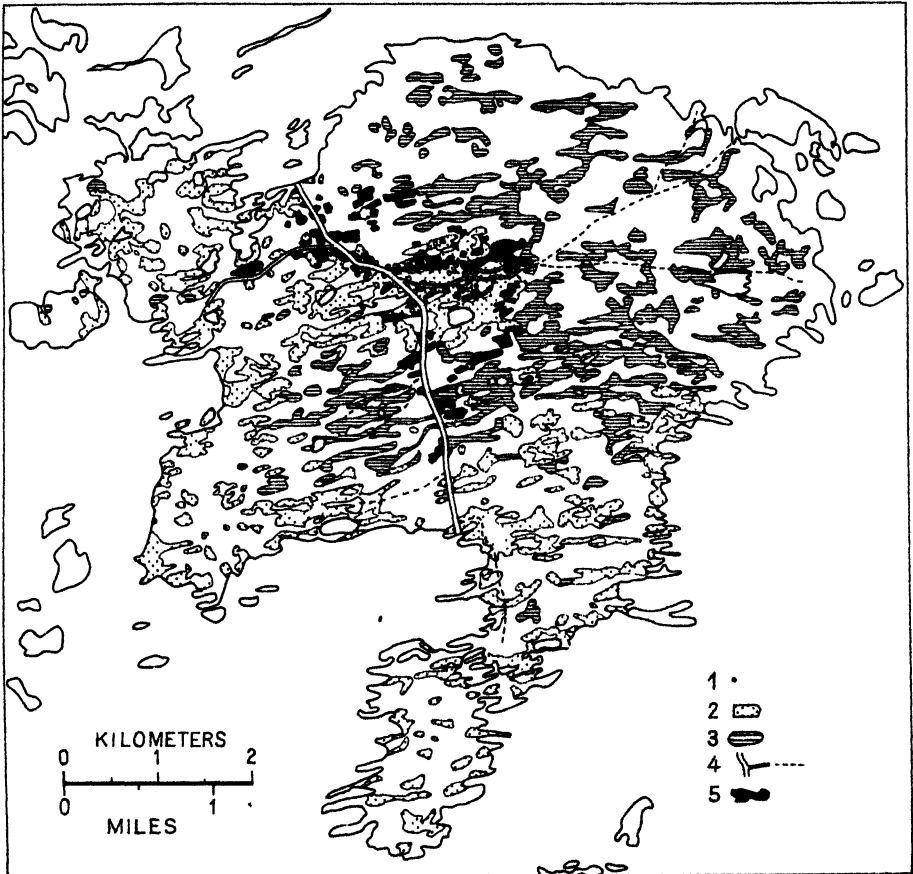


FIG. 24—Björköby after the surveyor C. Langhjem's map of 1857-1858. 1, settlement; 2, meadow; 3, swamp; 4, roads; arable land in solid black. Note absence of meadows in the pastured northeastern part of the island and streaky pattern of meadows and swamps, an adaptation to the morainic-drift pattern.

flecting the morainic topography, with forested ridges extending into the fields and patches of arable land stretching into the forest. This pattern is most striking in Björköby.

Up to the 1920's reclamation was carried on chiefly in the morainic areas. Present reclamation, however, is almost without exception directed toward drainage of marshlands. This was first undertaken in the eighteenth century but was not conducted on a large scale until the twentieth century. As a rule, the marshland areas are underlain by silt deposits and are fertile.

By continued land reclamation the cultivated area of the skerry guard has increased from 22.8 hectares in 1722 to 236 hectares in 1880, 704 in 1910, and 1184 in 1947. Four-fifths of the cultivated area has therefore been cleared since 1880, and two-fifths since 1910. As a result, since 1880 agriculture has become increasingly significant in the economic life of the islands. With the increase in total cultivated area has gone an increase in the average size of holdings. Until the nineteenth century they were small, averaging less than one hectare of arable land. In 1930 the average was 2.1 hectares.

Despite all efforts at reclamation, the skerry guard is still largely dependent on the mainland for its food. According to the bread and flour rationing data, only 31.1 per cent of the total population of Björköby commune are (1947-1948) wholly self-supporting and 4 per cent partly so. The corresponding percentages for Replot commune are 23.8 and 9.6.

THE PASTORAL ECONOMY

Nature favors animal husbandry in the skerry guard in many ways. From ancient times one of its most important natural assets has been its rich grass and pasture. The smaller islands offer pasture grounds naturally fenced by the sea, especially suitable for sheep and young cattle. The mild fall weather permits outdoor pasturing longer than on the mainland. In the alder groves the ground vegetation is well suited to both pasturing and haymaking, and the leaves of the alder, as of the other deciduous trees, serve as usable fodder for sheep. Dried leaves gathered into sheaves still constitute the essential part of the sheep's winter fodder; 120 sheaves per sheep are collected for a winter. Dried reeds (*Phragmites communis*), especially the ears, make good winter fodder for cows, and large stores are collected by the landless population.

As stock increased in the nineteenth century, the scarcity of winter fodder became serious. In spite of extensive meadow clearings, reaching a maximum area of 1841 hectares in 1910, large quantities of hay had to be imported almost every year. In recent times there has been a shift toward a modern pastoral economy, with winter fodder grown on the arable land. By 1920 the meadow area had shrunk to 815 hectares, and by 1941 to 179 hectares, 85 per cent of which was in Björköby.

The old custom of common summer pasturing in the forests is still followed throughout the skerry guard. However, a growing realization of the resulting damage to the forests is leading the farmers to shift the summer grazing to the hayfields after the harvest. The old system, still persisting to some extent, has been to reserve a fenced-off part of the main islands exclusively for summer pasturing. Here no meadow clearings are made, and



FIG. 25—Settlement on Klobbskat (top) and Gloskär-Paniki (bottom), almost entirely dependent on the fisheries (top of photograph west-southwest). Small hayfields in rough, boulder-strewn rock plain. Fish-curing factory, slightly left of center, is almost hidden by erratic blocks. Fisheries here are of ancient importance. In 1558 the fish tax collected at Klobbudden indicated a catch of 145 $\frac{1}{4}$ barrels (about 20,000 kg.). The small island at the lower right is still known as Finngrund, a relic of the time Finns were fishing at Klobbskat. (Finnish Air Force, Sept., 1942.)

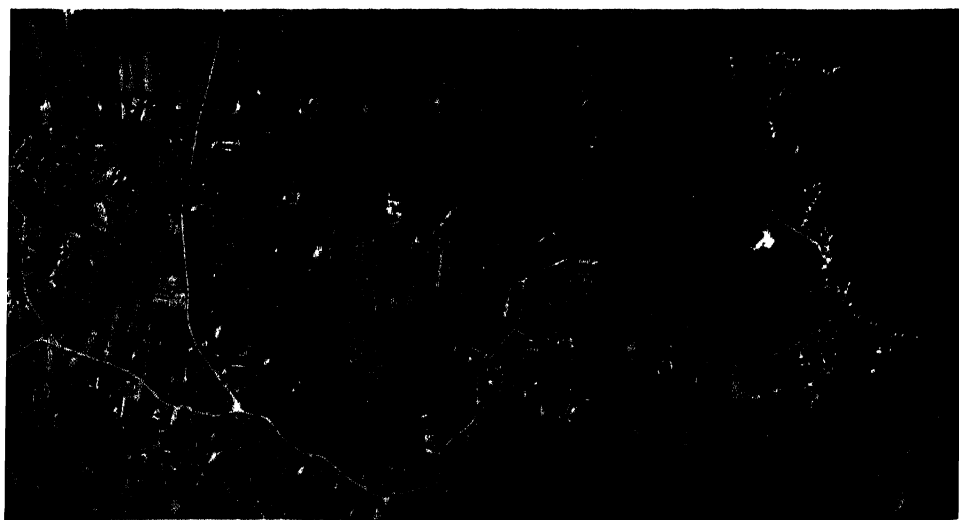


FIG. 26—North Vallgrund village with its main harbor (top of photograph northeast). The black line shows the approximate position of the eighteenth-century shore line; the squares, eighteenth-century dwelling sites. (Finnish Air Force, Sept., 1942.)

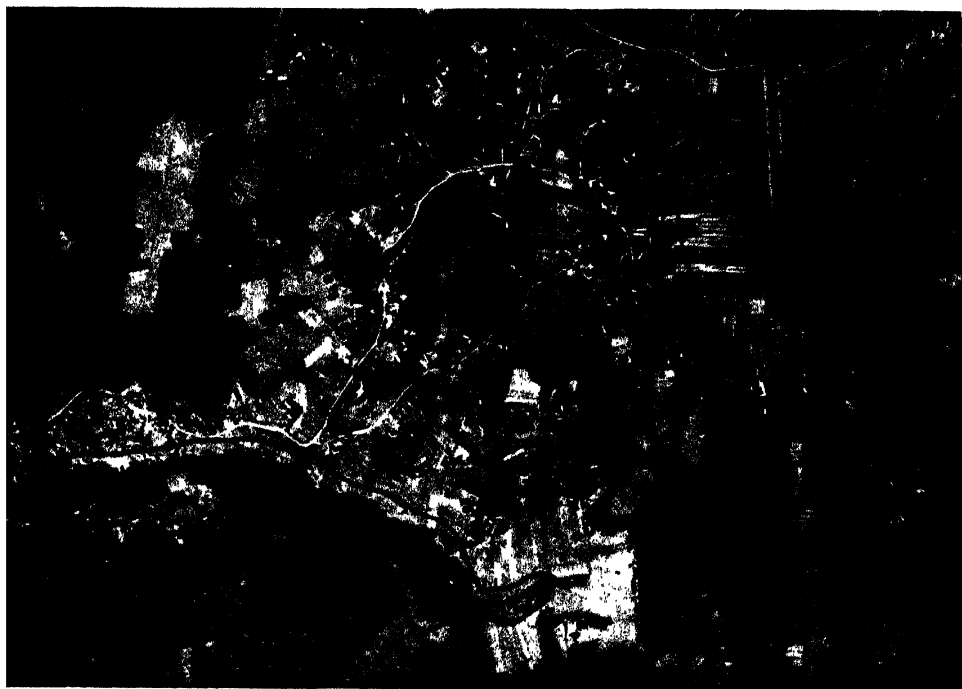


FIG. 27—South Vallgrund village and harbor (top of photograph north-northwest). The black line shows the approximate eighteenth-century shore line; the squares, eighteenth-century dwelling sites. To the lower left, the settled harbor site of Sommarösund. The sediment-filled pockets of the dissected peneplain are partly under cultivation. (Finnish Air Force, Sept., 1942.)

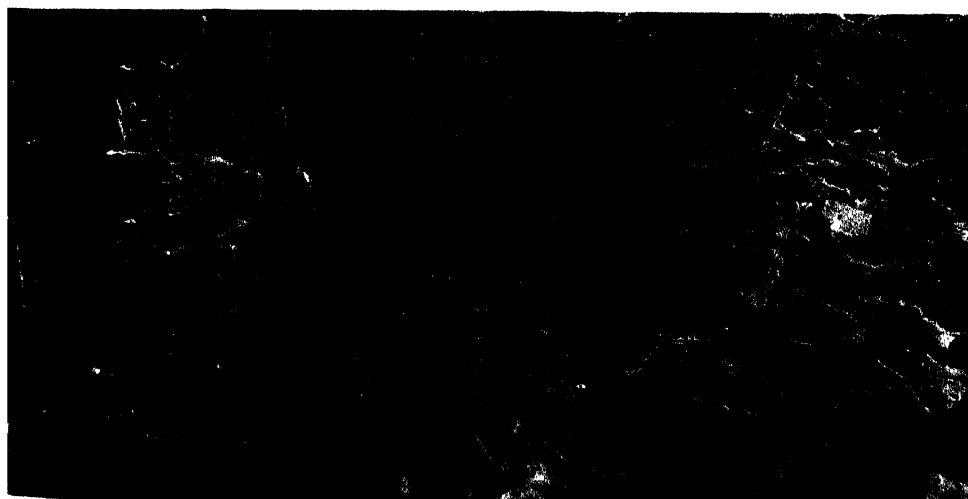


FIG. 28—Dried-up old *fladas*, drained 1936, on the west coast of Replot mainland (top of photograph north-northwest). Remnants of old fish verks are found between the embayments; one is supposed to contain seven channels, corresponding to the same number of habitations at a very early stage of settlement. The silty bottoms of the embayments are now being gradually put under cultivation. Note washboard pattern of the morainic drift on right and the drumlinlike features less clearly discernible on the left. (Finnish Air Force, Sept., 1942.)

here cattle graze until haymaking is finished in the rest of the island, when the gates are opened and the cattle are allowed to pasture everywhere.

In Replot and the Vallgrund villages sheep are grazed chiefly on the main islands. In Björköby, since the 1770's, when sheep pasturing on the main island was abandoned because of overstocking, sheep have been grazed on near-by smaller islands, which were left as common land in the redivision at the end of the nineteenth century. The sheep are transported in boats to the barren outer islands in spring. In the middle of the summer, after haymaking, they are taken to Lappörarna and grazed there until the second Monday in October, the Sheepday, when they are collected and brought home. All the adults of the village participate. The younger men land on one side of the island, the women and some of the older men on the other side, and the flocks are driven to the narrow cape in the southwest. There the legs of the sheep are tied together, and they are separated according to the earmark, summer-born lambs staying with the ewes. The owners then put up sail and transport their sheep home (Figs. 16, 19). Through the willing co-operation of the entire village this task is performed in 10 hours, from 2 a. m. to noon. The Vallgrund villages also have their Sheepday, when the flocks are driven out to promontories on the north side of the island.

Animal husbandry brings the farmers little cash, but the whole economy of the skerries has been, and still is to a large extent, essentially based on its products. Dairy cattle are the most important. In Björköby commune in 1941 only five holdings out of the 120 listed in the census were without a cow, in Replot commune 62 out of 436. But only 18.2 per cent of the cattle owners in Björköby commune and 10.7 per cent in Replot had herds larger than three cows, and the average yearly milk production per cow is not large, only 1490 kilograms. The cattle raising is mainly intended to supply milk and butter for the farmers themselves, though in some villages calves are raised for the city market. A project for collecting cream from the villages and transporting it to a butter factory to be erected in Replot village will, if realized, revolutionize the pastoral economy of the skerry guard.

Sheep largely outnumber cattle. In 1941 only one of the registered households in Björköby was without a sheep, and flocks of 5 to 10 full-grown sheep were common. In Replot commune, however, 88 holdings were without sheep, a sign of the breakup of the old self-sustaining economy. Some lambs are sold every fall. Moreover, mutton is the chief meat for home use; it is preserved for the winter by smoking whole carcasses in specially built kilns (Fig. 15).

The horse is an indispensable draft animal on the islands. It is widely

used for transport over snow and ice, and it is therefore kept even on tiny farms, despite the large demand it makes on the small winter fodder resources. Horses are commonest in Björköby and in the more isolated Brändövik-Söderudden settlements.

Stock other than horses, cattle, and sheep is unimportant. Poultry farming is carried on in a small way. Fur farming, mostly of mink, has developed during and since the war, chiefly in Björköby and the Vallgrund villages. This industry is well suited to the skerry guard because of the enforced idleness of winter and the ease of feeding the fur bearers from the fish not eaten by man—roach and other less valuable species.

MINOR OCCUPATIONS

The islanders are forced to make use of all the natural assets of their overpopulated land. Among these are large quantities of blueberries and red whortleberries and smaller quantities of raspberries. These are picked every fall and sent to the city market in Vasa; they bring considerable cash to the smaller households. Of much greater importance, however, is forestry. The small sawmills in Replot, North Vallgrund, and Björköby satisfy only local needs, but larger amounts of lumber, especially pulpwood, are cut in winter and hauled to the shores, where they are sold to lumber companies. Some firewood is also sold from the islands.

A rather large number of islanders get their living in the transportation services (see above), mainly as pilots and lighthouse keepers in the outer skerries. Their families live on the main islands (most of them in South Vallgrund, some in Replot village), and the men themselves always settle down there on retirement. The coast guard employs a small group.

Still more of the islanders earn their living in Vasa and visit their families in the skerry guard every week end (see below). This group is not regularly registered in the census, though the 1920 census recorded 352 "workers" who certainly did not work on the islands.

Fish-curing factories, sawmills, and flour mills serve the local needs, though wheat must be transported to mills on the mainland because the combination lumber and flour mills (rye, barley) of the skerry guard are not fitted to grind it. The isolation of the villages makes many home handicrafts necessary. Some larger manufacturing enterprises, serving outside markets, have also developed. One of these is boatbuilding, which is the main support of some 10 households, chiefly in Björköby and Replot. Every winter members of these families, working in primitive wooden sheds and using wood from the forests of the islands, build about a hundred boats.

Most of them are sold in Vasa, but some go farther afield, to Helsingfors and northern Finland, and a few boats have even found a market abroad. The newest and most important manufacturing industry of the skerry guard is fish-net knitting. A modern mill, erected in Björköby in 1942-1943, knits strong salmon nets, by a new method developed by an inhabitant of that village. About 50 workers, mostly women, are employed. The nets are exported, mainly to Sweden but also to the salmon fisheries of the Pacific coast of America.

DEPOPULATION OF THE ISLANDS

In the nineteenth century the population of the skerry guard increased rapidly, from about 800 in 1800 to nearly 3000 in 1900. Since at first there was no corresponding increase in the productivity of the islands, this led to overpopulation. The growth of the landless element was especially conspicuous. In 1800 fewer than one-sixth of the households listed in the parish register belonged to this class, but by 1890 it comprised 1519 persons, as compared with 1153 landowners. It has now been reduced to less than 12 per cent of the total population (about 22 per cent if landowners with less than half a hectare of arable land are included). The primary outlet for surplus population has been transoceanic emigration, mainly to the United States. This began in the 1870's, and from 1893 to 1930 the total number of emigrants was about 800. Another outlet has been emigration of workers to the mainland. Early in the twentieth century a seasonal shift began from the fishing harbors to the water front of the outer harbor of Vasa. Here, in the 1910's and 1920's, young islanders of both sexes worked at loading and unloading vessels. Later this seasonal shift changed to a definite emigration, the men finding permanent employment in the city as carpenters and mechanical workers, the women in the textile industry. The service boats to the skerry villages make extra week-end trips for these islanders working in Vasa. It is estimated that 200 to 300 persons carry on this seminomadic life.

The main stream of emigrants left the islands on the eve of a period when the productive capacity of the skerry guard was to be considerably increased, chiefly by land reclamation but in part by the exploitation of new fishing grounds based on the use of motor-driven boats, the introduction of manufacturing, and the development of closer connections with the city market. Nevertheless, the steady outflow that has marked the twentieth century still continues. For the period 1945-1948 the vicar reports certificates of removal distributed as follows: North Vallgrund, 40; Replot, 26; Söderudden, 20; South Vallgrund, 20; Björköby, 18. Whether this will come to a halt is

difficult to decide. Living conditions are rapidly improving. Electric lights were made available in the southern villages in the winter of 1948-1949. A primitive ferry traffic to the mainland is already carried on, and regular ferryboat communication is projected for the near future. It has been decided to build a bridge between Björkö and Replot islands. Thus the future may see the old skerry economy change into a more modern way of life. Probably there will be a seasonal reflux of emigrated islanders, and probably the rise of a summer resort industry, hitherto unknown on these low islands, with their shallow, boulder-strewn shores and intricate, deceptive fairways.

MARK JEFFERSON

MARK JEFFERSON died in Ypsilanti, Michigan, on August 8, 1949, in his 87th year. Professor Jefferson was a broadly educated man, with an equally broad cultural background that was visible through all he did. He took the classical course at Boston University and graduated with honors in 1889. His unusual skill in mathematics was indicated by his appointment as assistant at the National Observatory at Córdoba, Argentina. His work there consisted of painstaking observation and recording. Its precision and concreteness delighted him. All his many students will remember how he could bring tables of statistics to life, how he used them to open doors of understanding for men and women who were inclined to think that education consisted of textbook generalities.

After three years Jefferson left the observatory to become superintendent of a sugar hacienda at Tucumán. There he saw Argentina on that moving frontier of settlement in which the sugar *central* followed hard on the heels of the gaucho in the zone of irrigable piedmont in the northwest. It was this experience that singularly fitted him for the task of interpreting Argentine settlement many years later (1918), and the American Geographical Society made the most of the opportunity for geography by financing a season of field work and persuading him to undertake the task and eventually publishing "Peopling the Argentine Pampa" (*Amer. Geogr. Soc. Research Ser. No. 16*, 1926). It is a source book so far as Jefferson's personal comparisons of earlier and later times are concerned, and it is also an acute analysis of Argentine life by one who had lived it.

On his return to the United States, Jefferson served for a time in the Massachusetts public-school system, as teacher, principal, and superintendent. Two years were spent in study at Harvard, then a Mecca for aspiring young geographers because of the pre-eminence of William Morris Davis. In 1901, Jefferson was called to the chair of geography at the Michigan State Normal College, Ypsilanti, a position he held until his retirement in 1939. Here he was somewhat of a phenomenon. To many of the students he was the first broadly cultured man they had met. To some of the faculty members he was a delight; to the loose-minded an annoyance! His keen scythe could mow down a waving field of words at one sweep. He had a dryness and wit that sometimes offended the dull and that were a constant source of amusement to his friends.

In his classes one did not "learn about map projections" but made them after calculating the elements. One did not "learn" merely how to read a map on a desk but went into the field and made a map. The diagram in the book was not enough for understanding geysers—the student had to set up a laboratory geyser and make it work. The Foucault pendulum demonstration of the earth's rotation and a dozen other exercises taught the student things and processes firsthand and led him to acquire the habit of using his hands and eyes and brain and *creating* a substantial part of his knowledge of geography as he went along.

With small facilities Jefferson trained a host to teach geography with spirit and an understanding of basic facts and principles. And he kept his eye always open for the man or woman who had unusual abilities and after a year or two passed along his more talented students to the universities. Whoever their masters might then be, they never forgot Jefferson, the cultured schoolmaster and thinker who considered himself well placed where he was and never sought a university chair. Part of this contentment, it is true, was due to self-depreciation. He often said of himself that he was too sharp and did not get along with people easily. Also,

he wanted time and freedom to follow his bent. Emerson's writings meant much to him; for he had lived near Concord and grown up as a New Englander in the environment of authors and philosophers. For at least half a dozen years he had a passion for Kipling. He read widely in poetry, biography, and fiction, in French, German, and Spanish as well as in English. His



MARK SYLVESTER WILLIAM JEFFERSON

1863-1949

scientific reading was unsystematic yet sure, with an element of the venturesome. He cared little for academies as bestowers of honorifics yet cared greatly for whatever creative work they did. One of his most charming traits was his desire to tell the world when he had found a new idea or a new geographer whose tracks he had discovered in a journal or book. When Johannes Walther's "Das Gesetz der Wüstenbildung" appeared, he lived intellectually in the desert with Walther for a year or more. He never missed a number of *Petermanns Mitteilungen*, with its solid stuff. He rarely read a travel article. He had no taste for the subjective

and personal. His choice was concrete material that one could build into the permanent structure of science.

About every other year during the active part of his life he took a journey to a new place. One year it was Norway, and he learned to speak Norwegian so as to get closer to life there, only to find that almost everybody he talked with spoke English very well. A summer in France with Professor Davis and a few picked companions was a lasting inspiration. The influence of his inquiring mind ran ahead of his writing. He liked to talk, and he talked well. Writing was a chore. It took patience and long persuasion to get him to complete the book on the Argentine Pampa, after the earlier installments of the results of the "Expedition to the A. B. C. Countries" had appeared in 1921—"Recent Colonization in Chile" and "The Rain-fall of Chile" (*Amer. Geogr. Soc. Research Ser. Nos. 6 and 7*).

Jefferson had no use for stock material in teaching and threw away his own old maps and plates as fast as new ideas arrived. His "Teachers' Geography" went through many private printings before he could be persuaded to put it in the hands of a commercial publisher, with "all its ideas, originality, and crankiness," as that publisher said when "Principles of Geography" made its appearance in 1926. It has not been surpassed as a generator of basic mental activity. "Man in Europe," a book that should be in use in every university, shows him at his best in the use of maps, photographs, and *ideas* in the interpretation of a continent. In all his material for teaching, his skill with the pencil, his sense of line and letter, was evident. He made maps for his own pleasure as well as for teaching and publication. If Antarctic exploration was in the air, for example, he compiled a new map from good sources and incorporated the new findings to see what they meant. If a thing was important and mappable, he had to try his hand at putting it on paper. Color and form engaged his interest on field trips. He had learned from Davis the dangers of "the petrographic habit" as Davis termed it—kneeling on the ground and looking at a rock specimen through a microscope to the exclusion of a broad view of the relations of the field. Beside that phrase he put another: "Look up once in a while, man; the sky is also a part of the picture."

At the annual meeting of the Association of American Geographers held at Ypsilanti in 1931, among his friends and associates, the Cullum Geographical Medal of the Society was presented to him (*Geogr. Rev.*, Vol. 22, 1932, p. 305). The praise he heard was unexpected, and his remarks in later years showed that he was deeply moved and grateful for the recognition. It surprised him, he said, that on the same occasion his old students should make such a fuss about him. Life presented him with deep personal as well as professional problems, but his wit and interest were never dulled, as some of his letters of the past year attest.

Jefferson was appointed Chief Cartographer to the American Peace Commission at the Peace Conference of Paris in 1919, a job for which he was eminently qualified, though it took much persuasion to get him to join the team, because, as he said, "I work better when I'm alone." He directed the making of about five hundred original maps at the Conference, and no other delegation there had such prompt and useful service in laying tentative or alternative solutions of territorial problems before the various boundary commissions. A collection of his Peace Conference maps is in the library of the Society. He served for a time on a boundary commission designed to bring together cartographers of the different delegations to decide on symbols, "finding line" technique, sources for official maps, and final boundary details. Although he had no part in substantive territorial decisions, he was quick to see how they could be graphically represented. Respect for his work was not confined to the American delegation. Younger men found him a delightful and informing companion in rare strolls

through the streets of Paris, and he was constantly being "discovered" by thoughtful higher-ups. Once, when it was suggested he would be useful to a government department, he replied that even the thought of living in the hubbub of government made him physically ill.

Thoroughness marked all his work. The highest principle he recognized was that if you are to explain a matter you must know it through and through. As he kept his own feet on the ground, so he put the feet of others on the ground. It was the ground first, then climate, and after that he was ready to *interpret* while always on the lookout for the inexplicable and the capricious in his own culture as well as in another's. Physical geography, as all his students will remember, had to begin with physical principles. Never, never, would he let words take the place of understanding. You had to *know* why the wind blew and the rain fell! His writings show that he could grasp and handle competently the largest concepts and forces of culture and life, but he approached them through experience, facts, realities. Social forces detached from the earth he left to other disciplines. For himself he tried to find out what rooted men. Perhaps this was partly the result of his old-fashioned classical training; perhaps it was due to the rigors of mathematics that he loved. Whatever the cause, it made his work enduring.

ISAIAH BOWMAN

THE AMERICAN GEOGRAPHICAL SOCIETY

Appointment of the New Director

A new Director of the American Geographical Society was named by the Council on December 6 (see pp. 1-3). Dr. George H. T. Kimble, Chairman of the Department of Geography at McGill University in Montreal, has accepted the appointment and will begin his new duties in June.

The Society's Lectures

The Society's lectures this season will again comprise two series, now to be designated Regular and Special Meetings instead of Series A and B, as formerly. Both series will be held in the Engineering Societies Building, 29 West 39th Street, the Regular Meetings in the auditorium and the Special Meetings in the lecture hall (Room 502). The Special Meetings continue to be of a more technical nature, directed primarily to Fellows with a scientific or professional interest in geography.

The first Regular Meeting was held on November 15, 1949. Dr. Richard U. Light, President of the Society, presiding. Dr. Robert Cushman Murphy, Lamont Curator of Birds at the American Museum of Natural History and a member of the Society's Council, gave a talk on "A Naturalist in Changing New Zealand," based on observations made during his trips to that country in 1947 and 1948. The lecture was illustrated with slides and motion pictures in color, which featured unusual views of bird life, the excavation of skeletons of moas and other extinct species, and a two weeks' visit to The Snares, an uninhabited sub-Antarctic island, where the penguins are of particular interest.

Mr. Maynard M. Miller, research assistant in glaciology on the Society's staff, initiated the season's Special Meeting series on December 6 with a talk on "Glacier Studies in Alaska and Patagonia." He described the Society's program of field observations and correlative studies in North and South America and discussed the glaciological work undertaken on the Juneau Ice Field in Alaska during the summers of 1948 and 1949 and in Argentine Patagonia during the winter of 1949. Mr. Miller's talk was also illustrated with slides and motion pictures in color.

Subscriptions to "Current Geographical Publications"

In order to cover increased production costs, it has been found necessary to raise the annual subscription rate of *Current Geographical Publications* to \$6.50. This price will include the ten numbers and index issued each year.

Distribution of Title Page, Contents, and Index of Volume 39 of the "Geographical Review"

The title page, table of contents, and index of Volume 39 of the *Geographical Review* (1949), issued separately, will shortly be ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

GEOGRAPHICAL RECORD

NORTH AMERICA

NORTH AMERICAN PERMAFROST AND SOME RELATED PHENOMENA. The origin of permafrost, its distribution and depth, and its influence on vegetation and drainage are of more than theoretical importance. During the war, knowledge of such matters proved to be essential to the carrying out of engineering activities in the Arctic, and John L. Jenness has recently pointed out that a better understanding of them "may ultimately open up vast new tracts of land within the largest undeveloped areas of the world" (*Permafrost in Canada, Arctic*, Vol. 2, 1949, pp. 13-27, and 2 maps following p. 76).

The formation of permafrost requires that the mean annual temperature be less than 0° C. From the rather meager information available Jenness has mapped the probable distribution of continuous permafrost in Canada and shows that its southern limit coincides approximately with the mean annual isotherm of 5° C. More detailed information is needed concerning both temperature and permafrost, and Jenness emphasizes the contribution travelers in the Arctic can make if they will "probe the ground during middle or late August, the time of maximum thaw, and record any occurrence of permafrost." He suggests that "permafrost may be less closely related to the mean temperature for the entire year than to the ratio between the winter's mean temperature combined with its length, and the corresponding mean temperature and length of the summer."

Within the area of suitable temperature the presence of permafrost and its depth are dependent on a variety of other factors, such as precipitation, cloudiness, direction of prevailing winds, degree and direction of exposure to the sun, the insulating action of vegetation and water covers, and, most important after climate, the conductivity of the soil. These factors also affect the thickness of the active layer, subject to annual freezing and thawing, and this in turn affects the composition of the forest, in the forested parts of the permafrost zone. Where the active layer is shallow, as in heavy clay soils or in ground insulated by muskeg, shallow-rooted trees, such as spruce, balsam poplar, birch, tamarack, and larch, are found. In sand or gravel areas, where the active layer is thicker, the deeper-rooted pines thrive.

Under present-day temperature conditions permafrost can form to a depth of some tens of feet. At Port Nelson, for example, recent drainage of a swamp resulted in the formation of permafrost to a depth of 30 feet. Maximum depths are much greater than this—an estimated 1000 feet or more in Siberia and more than 500 feet in Alaska. Such depths are clearly inherited from the colder climate of the Pleistocene, but whether they date from the beginning of glacial time or from one of the later glacial stages cannot be determined. Jenness suggests that where the permafrost is very thick it may represent the combined results of several successive glacial stages. During an interglacial stage the permafrost of the preceding cold period might not disappear entirely. "Soil could accumulate over it and bury it still deeper, but this soil in turn would become permanently frozen when the climate deteriorated again." Such recurrent growth could continue until the permafrost "reached a state of equilibrium, when any increase at the surface would be counterbalanced by a thawing at the base brought about by a rise of temperature with pressure." This theory can also explain the occasional presence, deep within the zone of permafrost, of a layer of unfrozen ground. It "must represent either the lower part of an ancient active layer, which,

in the course of a long mild period, became so thick that a recurring cold age failed to freeze it to the bottom, or else it was an aquifer within that ancient active layer that failed to freeze because of high mineralization or hydrostatic pressure."

"Islands" of permafrost south of the main body indicate a northward retreat of the boundary in the relatively recent past, a retreat that is probably still in progress, in view of the amelioration of climate widely reported in the Northern Hemisphere. In the Archangel region, for example, the Russians report a shift of almost 60 miles in the past 96 years. If this trend continues, "it opens up a vista of economic expansion into regions which today still remain outside the pioneer fringe."

Because frozen soil contains lenses and veins of clear ice in volumes much greater than the natural porosity of the unfrozen material, thawing of permafrost results in surface subsidence. When deeper permafrost is still continuously present to impede underground drainage, such thaw depressions contain thaw lakes (David M. Hopkins: Thaw Lakes and Thaw Sinks in the Imuruk Lake Area, Seward Peninsula, Alaska, *Journ. of Geol.*, Vol. 57, 1949, pp. 119-131). Where deep ice wedges have melted, the depressions have been drained, leaving thaw sinks. These are a useful indication of "the presence of thawed zones in a permeable substratum in which some supply of ground water can be expected." Also, where thaw depressions are present, "considerable subsidence can be expected . . . if the surface vegetal mat is disturbed or if the ground is heated beneath poorly insulated buildings."

In the Arctic Coastal Plain of northern Alaska, where permafrost is present at a depth of a few inches, 50 to 75 per cent of the surface consists of lakes and marshy ponds. Observations from the air reveal that most of these thousands of lakes, scattered over an area of more than 25,000 square miles, are elongated. Their long axes range in length from a few tens of feet to more than nine miles and are strikingly parallel, the orientation ranging from N 9° W to N 21° W (Robert F. Black and William L. Barksdale: Oriented Lakes of Northern Alaska, *Journ. of Geol.*, Vol. 57, 1949, pp. 105-118). Such "remarkable parallelism . . . is a rare phenomenon and, so far as is known, is duplicated in such a marked degree only by the Carolina 'Bays' of the Atlantic Coastal Plain Province of the United States. The uniformity of alignment of the lakes is so perfect in many parts of the Arctic Coastal Plain that their orientation has been used as an aid in air navigation." Some of these lakes "are believed to be the result of uplift and segmentation of lagoons," aligned in rows between former beach ridges. Most of them, however, are a result of thaw subsidence, as described above. Since such caving in cannot of itself account for the regional orientation of the lakes, the authors suggest that it was controlled by prevailing winds in the direction of elongation of the lakes. This would require that during the Pleistocene the prevailing winds of the region were, for some unknown reason, either northwesterly or southeasterly, in contrast with the present prevailing northeasterly winds.

SUBMARINE CANYONS IN THE LA JOLLA AREA. Evidence derived from wire and echo soundings and from descriptions and submarine photographs obtained by a diver reveals that the La Jolla submarine canyons, like the land canyons of the area, are characterized by vertical or overhanging rock walls; narrow tributaries, accordant or hanging, and more numerous in the upper reaches than in the lower; sharp, often rectangular, bends; and rock steps in the floors (Francis P. Shepard: Terrestrial Topography of Submarine Canyons Revealed by Diving, *Bull. Geol. Soc. of America*, Vol. 60, 1949, pp. 1597-1611).

Because of these similarities, and because no submarine currents capable of cutting the canyons were observed during the diving operations, which extended over a year, Shepard concludes that the submarine canyons must have been cut by streams. Since they show no "sudden change in character at 40-60 meters below sea level nor, for that matter, at much greater depths," the moderate lowering of sea level caused by continental glaciation is insufficient to account for them. Shepard therefore postulates that, "in the very late Tertiary or in the Pleistocene, not only the shelf but the steep upper slopes of the San Diego Trough off La Jolla were above water." Since the canyons were thus cut before some or all of the glacial stages, they have been modified by the "swinging sea levels of the Pleistocene." During glacial stages of lower sea level the inner parts of the canyons were subject to headward erosion, and on the inner shelf alluvial fans accumulated. During times of higher sea level, land-derived sediment would tend to accumulate in the canyon heads. At present they receive sediment at a rate rapid enough to fill them in a few decades. That they have not been filled, in the 10,000 to 25,000 years since the rise of sea level at the end of the Wisconsin, is attributed to the intermittent removal of the fill by mudflows or landslides.—ANASTASIA VAN BURKALOW

EUROPE

THE FUTURE OF FINLAND. "The recurring tragedy of Finland is that of a marchland state . . . between the Russian circle of strategic control and the Atlantic circle of economic control." W. R. Mead, author of many articles on Finland and the Scandinavian countries (including "Finland in the Sixteenth Century," *Geogr. Rev.*, Vol. 30, 1940, pp. 400-411), thus begins his examination of "The Finnish Outlook, East and West" (*Geogr. Journ.*, Vol. 113, 1949, pp. 9-20). The territorial losses sustained in 1944 reduced the country's resources by more than one-tenth (see also J. Hampden Jackson: Finland since the Armistice, *Internat. Affairs*, Vol. 24, 1948, pp. 505-514). The loss of Viipuri deprived Finland of her second city and first exporting port, and along with it went loss of the Saimaa Canal, channel for the main timber trade. The loss of Petsamo cut off access to Arctic waters. The Lake Inari exit also was cut. Helsinki's communications are handicapped by the enforced lease of the Porkkala base. The reparations demand, calling for more than one-third delivery in metal products and machine goods, has altered the economic structure of the country. Capital and labor have had to be diverted to new industrial establishments in the metropolitan area. By 1947 one-third of the industrial workers were employed in metallurgical plants. Nearly one-third of the developed hydroelectric power was lost when the Vuoksi River was bisected, and in the fall of 1947 the power situation was serious (see Bror Nordqvist: Prospects of Power Supply in Finland, *Bank of Finland Monthly Bull.*, Vol. 22, Nos. 5-6, 1948, pp. 19-26).

Population loss was not commensurate with territorial loss, for no fewer than 400,000 persons left the ceded territories; this created a relocation problem. Dr. Mead shows the redistribution scheme and the actual population transfer on two maps. Predominantly Swedish-speaking coastal districts and the north were excluded from the scheme, the latter because to the natural difficulties of settlement was added the wartime destruction: it was "rare to find a house, a bridge or even a telegraph pole in Finland north of the Arctic Circle," and reindeer herds had been slaughtered. Dr. Mead reports reconstruction at Rovaniemi, the northern capital, well under way.

The chief wealth of Finland is still her forests, and European demands for forest products are greater than ever. The total forest area of the country is now placed at about 53,500,000 acres. The forests lost in Karelia, some 12.5 per cent of the total, included the best stands in Finland (M. L. Anderson: *Scandinavian Forestry*, III: Impressions of Forestry in Finland, *Empire Forestry Rev.*, Vol. 27, 1948, pp. 31-44). The decline in world prices of forest products, especially pulp and paper, is a blow to Finland's export trade (Robert M. Brandin and Robert I. Owen: Finland's Major Export Industries Face Prospect of 1949 Contraction, *Foreign Commerce Weekly*, Vol. 37, No. 3, 1949, pp. 3-5 and 44-46). Agricultural losses include the young farm workers killed during the campaigns and the drain of population from the rural to the urban areas. This movement had been in operation for several decades in parts of the country (see Helmer Smeds and Jorma Mattila: Om utvecklingen av tätorter och landsbygd i Finland 1880-1930, *Geografiska Annaler*, Vol. 23, 1941, pp. 210-238; English summary, "On the Development of Urban and Rural Areas in Finland since 1880," pp. 235-237). At present, though the absolute decline in rural population is not marked, there is "a substantial relative decline." Finland needs to maintain and expand her agriculture; grain imports in particular are heavy. Limits of cultivation are being extended, but more hopeful are the prospects for greater yields. New varieties are being bred in collaboration with Swedish institutes, and crosses are also being made with Canadian and Russian strains. The research station at Apukka, just north of the Arctic Circle, had excellent stands of spring wheat in 1948, and so had near-by private holdings. Experiments are being made with crosses of rye and wheat. Improvements in animal husbandry include work on pastures and pasture and feed systems. Mineral resources are still not fully exploited, or indeed explored. The Outokumpu copper deposit is said to be the largest in Europe (Aarne Laitakari: Ore Resources in Finland and the Use of Them, *Bank of Finland Monthly Bull.*, Vol. 22, Nos. 7-8, 1948, pp. 23-27).

LAND RECLAMATION IN HOLLAND. In 1931 the *Geographical Review* published an article by K. Jansma, secretary of the Zuider Zee Board, on the beginning of the Zuider Zee reclamation project ("The Drainage of the Zuider Zee," Vol. 21, 1931, pp. 574-583). Observations made in the area in the summer of 1948, together with interviews and correspondence with inhabitants and with government officials, enable the present writer to report on developments since Dr. Jansma's article appeared.

It will be recalled that the project included the reclamation of four polders. The diking and draining of the first polder, the 49,500-acre Wieringermeer, were completed by 1930—about 9 per cent of the total reclamation project. Of this area, 90 per cent, or 44,500 acres, has been brought under cultivation; the remainder is used for roads, villages, canals, and forests. From 1938 to 1940 the cultivated areas of the polder were as follows: 77 per cent in field crops—mainly wheat, rye, oats, barley, peas, flax, potatoes, and sugar beets—fodder, and hay, 17 per cent in grassland, 4 per cent in fruits and vegetables, and 2 per cent in farmyards.

Urkerland or Northeast polder, covering 118,000 acres and including the island of Schokland, has also been completed. Because of the war it took much longer to build this polder, and land was not leased until 1947. Two other polders are to be reclaimed in the near future, one, the Southwest, covering 132,000 acres and the other, the Southeast, 260,000 acres. Work on these was begun in 1949, but because of their size, the diking and draining alone will take seven to eight years. According to recent newspaper reports, the European

Recovery Program has given the Netherlands government permission to use counterpart funds in the financing of these projects.

The creation of the four polders will change the entire economy and purpose of the Zuider Zee. The new fresh-water lake, the IJssel Meer, with a total area of more than 300,000 acres, will be available for agricultural and industrial uses, and for inland transportation to North Holland and Friesland. It will also provide drinking water for cattle, a matter of special importance between April and August, when the weather is usually dry. Surplus water can be discharged through the sluices into the Wadden Zee and thus into the North Sea.

Toward the end of the war the Germans flooded the Wieringermeer by blowing up the dike seven miles south of Den Oever. A few days later a storm caused additional damage. At the same time that the water of the IJssel Meer flooded the polder, the Germans opened the sluices at high tide and salt water entered the lake. They had also prepared to dynamite holes in the Urkerland dike but were prevented by Polish workers. Each of the two gaps blown in the Wieringermeer dike widened to almost 600 feet, with 90 feet of the dam left between them. Only 60 of the 512 modern farmhouses built since 1935 remained; three villages of 1100 houses disappeared. Rebuilding was begun on June 21, 1945, and by August 5 the two gaps had been closed.

A few days after the dike was repaired, the pumps that had remained intact, together with auxiliary pumps, started, for the second time within a generation, to drain the water from the polder. The draining was finished in less than six months. Speed was important; roads, bridges, and canals were saved that would have been destroyed had the water level subsided slowly and permitted the waves to scour the bottom. Since the damage from the salt was slight, it was possible to reseed the polder in the middle of April, just one year after the bombing. Only 3400 acres near the gap remained untillable when the writer visited the polder in the summer of 1948. It was hoped that all 44,500 acres would be under cultivation in 1949 and that many of the destroyed houses and much of the machinery would have been replaced.

The Wieringermeer was reclaimed and brought under cultivation by the state, and the land is leased for terms. The rent for the new farms was low for the first two years, then increased gradually until the fifth year, when it was comparable with that for similar lands elsewhere. After a few years this polder gave yields equal to, and often better than, those of the rest of the Netherlands. More than half of the farms on the Wieringermeer are smaller than a hundred acres—a total of 491 farms in addition to 37 experimental farms managed by the state and leased to farmers.

The Zuider Zee project has focused attention on land reclamation in relation to population problems. The population of the Netherlands increased from 6 million in 1910 to 10 million in 1947—about 66 per cent—whereas the agricultural land has increased only 11 per cent (5,625,000 to 6,250,000 acres). In the new Zuider Zee project it was decided to establish a regional center for 30,000 to 40,000 people and numerous smaller towns and rural villages. It is estimated that upon completion of the project about 300,000 people will be living in these reclaimed areas. Besides new farming jobs, land reclamation will also create new employment opportunities all over the country. Although reclaimed land will never absorb the entire surplus population, it will at least help to reduce food imports. Many foodstuffs grown in the country provide raw material for Holland's factories and numerous job opportunities.

Additional arable land can come only from further reclamation. Anyone who has

visited Holland will readily agree that wasteland does not exist. When the reclamation of the Zuider Zee is completed, 560,000 acres of valuable soil will be available, an increase of 7 per cent of the total area of the country and 10 per cent of the total arable land.

The government and the privately sponsored Netherland Association for Land Reclamation are at work on plans for additional land reclamation projects. The association "visualizes one continuous coastline from the Belgian border to the German frontier." This project would reclaim all the land in the southwestern province of Zeeland, the waterways and sandbanks of South Holland, and the islands along the Frisian coast. As the association states in one of its announcements: "The only gaps in this coastline would be the locks in the waterways giving access to the ports of Antwerp, Rotterdam, and Amsterdam. Behind the coastline, virtually every waterway, except those needed for drainage, would be reclaimed." Further plans are being made to reclaim the Wadden Zee of North Holland, which, together with the land to be reclaimed in Zeeland, would add 950,000 acres of soil. The reclamation of the Wadden Zee, which is partly exposed at low tide, would not only add new farmland but would also prevent sea water from coming up the tidal rivers and depositing salt in the old and new polders.—GEORGE W. HOFFMAN

A NEW GERMAN GEOGRAPHICAL ANNUAL. For 12 years, 1903 to 1914, the *Geographen-Kalender*, founded by H. Haack, was published annually. In 1949, at the instance of the association of teachers of geography in the higher schools, a successor appeared, the *Geographisches Taschenbuch*, edited by E. Meynen. It is to be published annually, by the Reise- und Verkehrsverlag in Stuttgart (Kienestr. 45), with the purpose of fostering the regional geographical study of Germany. The following examples reveal the wide range of the subject matter: a list of events, past and future, of geographical interest; information on maps and publications, including geographical bibliographies and basic source books; discussions of the status of regional geography in Germany and advice on how to carry out regional studies; statistics, such as elevations of German mountains and cities, lengths of German rivers, and areas and populations of parts of Germany; tables of physical constants and of weights and measures; and information concerning the important geographical, geological, and related institutions in Germany. The names and addresses of more than a thousand German geographers are listed.

ASIA

DEW IN PALESTINE. Dr. Charles F. Brooks has forwarded to us a letter (dated August 22, 1949) from M. H. Gutfeld, director of the Meteorological Service of Israel, commenting on Dr. D. Ashbel's article on "Frequency and Distribution of Dew in Palestine" in the *Geographical Review* of April, 1949. Mr. Gutfeld writes as follows:

"I feel it my duty—as successor to the late Mr. Feige, who introduced dew observations according to Mr. Duvdevani's methods in the network of the State Meteorological Service—to reply to some points raised by Dr. Ashbel, which may unfavourably reflect upon the scientific soundness of Mr. Duvdevani's method.

"The 'optical readings' used by the Meteorological Department of the Hebrew University since 1933 are quantitative estimates with the qualifications 'much,' 'medium,' and 'little,' which are in no way connected with quantitative 'measurements.' There are no fixed standards to which an observer can refer when choosing one of these three qualifica-

tions; and the estimates of the observers must of necessity vary from place to place. It is difficult to see how one can derive from these three qualifications a map showing 'Annual Dewfall in millimeters.' I cannot see any way to represent dew amounts on a map at all, owing to the character of this form of condensation whereby so much depends upon the very local conditions; and we have until now successfully resisted numerous requests to publish a map showing dew amounts in the conservative manner of climatological maps. We did represent the monthly distribution of dew amounts as measured according to Duvdevani at different stations in the form of dew roses [a copy was attached to Mr. Gutfeld's letter].

"If you remember the equivalents Mr. Duvdevani found between the form and size of dewdrops on his depositor and the weight of the condensed water, in thousands of weighings and measurements undertaken over a large number of years under varying conditions and on a large number of different depositors, and if you recall Mr. Duvdevani's diagram showing dew equivalents in his article 'An Optical Method of Dew Estimation' (*Quart. Journ. Royal Meteorol. Soc.*, Vol. 73, 1947, pp. 282-296), you will agree that there is an essential difference between 'optical readings' made by the observers of Dr. Ashbel and the method used by the observers of our stations, a difference which does not seem to justify the comparison between both methods, which Dr. Ashbel suggests in his article, and his characterisation of the 'innovation' made by Duvdevani.

"I regret that Mr. Duvdevani will not be able to attend the conference on 'The Conservation and Utilisation of Resources' at Lake Success to give you additional information on his method and to report on the progress he has made during the last months in his field of research; but we hope that his findings will be of great use in our endeavours to further stimulate agricultural work under semiarid conditions."

THE POPULATION OF CEYLON. "The movements of people, the contact and accommodation of cultures, and the interpenetration of Western and Eastern economies within an evolving political setting have made demographic laboratories of many of the islands that lie off the coasts of Asia." This is exceptionally true of Ceylon, with its "prolific historical records and the incomparable analytical potentialities of the current censuses and vital records" (Irene B. Taeuber: *Ceylon as a Demographic Laboratory: Preface to Analysis, Population Index*, Vol. 15, 1949, pp. 293-304). Elsewhere in this number of the *Geographical Review* (pp. 42-66) the relations between estate and native agriculture have been described. Dr. Taeuber gives some figures on the labor employed. At the end of 1948 the 1540 reporting estates enumerated 587,000 workers, 84 per cent adult, with a slight preponderance of men (44 to 40). More than three-quarters were Indian, but there were sharp differences according to crop and region. The tea estates were the heaviest users of labor, and in the area of concentrated production (cf. Fig. 18, on p. 55) 85 to 90 per cent were Indian. Rubber used only a fifth of the number employed on the tea estates, the proportion of natives was much higher, there were more men and fewer children. As a whole, estate life effectively isolates Tamil from Sinhalese, and the question of the future of the former arises with the prospective decline in the old colonial economy.

That economy was based on a balance between import of basic foodstuffs—the island was only one-third self-sustaining—and export of products controlled by quotas and fluctuating prices in world markets, and obviously it had its dangers. The emergency created

by the failure of the southwest monsoon in 1934 and the malaria pandemic of 1934-1935 sounded a warning note. As all writers on Ceylon point out, the island is, and must for long remain, dependent on agriculture, with the relation between food resources and population a prime question. In the last three-quarters of a century—since the first census, taken in 1871—population has increased threefold. At the latest census (1946) it was 6.6 million; an estimate for the end of 1948 places it at 7.2 million. Most significant is the recent rise in the rate of population increase, attributed to a dramatic lowering of the death rate through the use of insecticides in combating malaria and other insect-borne diseases—natural increase, which had been 17 or 18 per 1000 in 1941-1946, is put at 25 in 1947 and 27 in 1948. This suggests a potentially acute population problem. Pressure on resources, however, is not a new thing in Ceylon. From the historical records “the evidence seems incontrovertible, though, that a great civilization once arose on the basis of an irrigated rice agriculture that both necessitated and sustained dense human occupancy of the land, but, as the central order disappeared, proved unable to attain the permanent balance of food and people that would permit survival.” Whether for study of past or present, Dr. Taeuber’s “preface to analysis” is a stimulating invitation to research.

HUMAN GEOGRAPHY

THE SOCIAL MOTIVES IN GEOGRAPHICAL ANALYSIS. In a recent article on the evolution of German geography, Professor Carl Troll stresses that in the “*adoption by social science of the naturalistic-materialistic doctrines of biology* lies the real root of Ratzel’s teaching and in general of the over-evaluation of the milieu in geography since then” (Geographic Science in Germany during the Period 1933-1945: A Critique and Justification, translated [in part] by Eric Fischer, *Annals Assn. of Amer. Geogrs.*, Vol. 39, 1949, pp. 99-137). What Troll considers to be a nineteenth-century imprint might perhaps be traced back to the nationalism of the eighteenth century, which the twentieth carried to unreasonable extremes. Still, as Troll remarks, “French *géographie humaine* began to investigate the social and economic motives of development and to focus attention upon the ‘Genre de vie.’” Some trends stemming from this early reaction against too much materialism have recently developed and are worth attention.

A new and interesting series of publications, *Cahiers de la Fondation Nationale des Sciences Politiques*, published in Paris since 1948 under the auspices of a renowned school of political science, devotes much space to geographical problems, stressing the social and, especially, the psychological or religious factors in several excellent studies. The series begins with a small volume on “electoral sociology” (Charles Morazé, R. B. MacCallum, Gabriel Le Bras, and Pierre George: *Études de sociologie électorale*, Librairie Armand Colin, Paris, 1948), which could equally well be called a study of the social factors in political geography. Two of the authors, Professors Pierre George and Charles Morazé, have consistently laid stress on the economic aspects of the problems they have studied. Of great importance is the contribution of Professor Gabriel Le Bras of the Law Faculty in the University of Paris, who has been actively orienting French geographers toward a study of the religious factor in regional problems. These methods of investigation are applied in two monographs on small areas, “Les paysans de Morette: Un siècle de vie rurale dans une commune du Dauphiné” by J. Garavel (*Cahier No. 2*, 1948) and “Thurins: Démogéographie d’une commune rurale de l’ouest lyonnais” by Paul Guiot (*ibid.*, No. 10, 1949). The first deals

with the evolution during the past century of a rural community strongly influenced by its outside contacts; the second describes a local prosperity maintained by combined rural and industrial activities.

Every geographer could derive inspiration from André Siegfried's masterly analysis of the political behavior of a French *département* in his "Géographie électorale de l'Ardèche sous la III^e République" (*ibid.*, No. 9, 1949). This is a section of a major work on the political geography of southern France, conceived as a companion volume to his standard work on western France (*Tableau politique de la France de l'Ouest sous la Troisième République*, Paris, 1913). Professor Siegfried, now president of the Fondation Nationale des Sciences Politiques, has had a profound influence on social thought in France and other countries, orienting it toward regional problems and the interplay of the various factors. His many studies of democratic countries, brilliantly analyzing their "personality," from his doctoral dissertation, on New Zealand (*Le démocratie en Nouvelle-Zélande*, Paris, 1904), to his latest volume, on Switzerland (*La Suisse, démocratie-témoin*, Neuchâtel, 1948), are not only classical monographs; they have created a new genre in geographical literature.

It is a delight to follow Professor Siegfried in his survey of the political divisions of Ardèche, so strongly marked on the maps of the voting at elections since 1871—a political geography that has its roots not only in the antagonism between highlands and valley, in the economic diversity, but much more in the old antagonism between Catholics and Huguenots, between those who approved or disapproved the Revolution of 1789. The ruined castles atop the hills, of the lords now disappeared, whence for centuries the peasants were oppressed and taxed, still cast their shadows! "Social structure, i.e. the division of society into social classes, plays a decisive part in the formation of opinion and the orientation of the vote. Personal benefit is here a predominant factor. But it is not, as one often thinks, in the individual and immediate form. The mechanism is more involved, in that one combines a certain personal disinterestedness with service to the group to which one belongs . . . : the peasant understands in a certain way the peasants' interests, the industrial worker those of the workers . . . It boils down to as many myths, and people vote according to their way of understanding life." This social and collective interpretation brings the psychological factor into "regionalism" and into the "way of life." On the level of a more involved society, we are coming close to what Ruth Benedict called "patterns of culture" in her study of primitive peoples.

The psychological factor, so strongly influenced by the religious motive, and the pattern of education seem essential to this reviewer (see his "De la méthode d'analyse en géographie humaine," *Annales de Géogr.*, Vol. 56, 1947, pp. 1-12; and "Doctrines géographiques en politique," in "Les doctrines politiques modernes" [a symposium], New York, 1947, pp. 17-40). Man does not act as an individual toward either the physical or the social environment; he acts as a member of a group, and education has always endeavored to put on him the imprint of the group, to saturate him with its solidarity and traditions, at the expense of his natural reactions as an individual or as a biological organism. The struggle for the liberation of the individual has always been carried on within certain limits because the community alone can guarantee that liberation.

The social motive is studied through its economic channels in two other volumes of the *Cahiers*, one dealing with government planning in Czechoslovakia (Guy Braibant: *La planification en Tchécoslovaquie: Le plan biennal*, *Cahier No. 6*, 1948), the other with the

need for decentralizing French industry (Gabriel Dessus, Pierre George, and Jacques Weulersse: *Matériaux pour une géographie volontaire de l'industrie française*, *ibid.*, No. 7, 1949). In the second volume Gabriel Dessus covers the subject in its general aspect, Pierre George illustrates it with a statistical survey of industrial establishments according to their size, and the late Jacques Weulersse takes up the specific case of a large industrial plant in the midst of a rural district, the metallurgical plant of Tillières-sur-Avre, in Normandy. The social viewpoint dominates this excellent monograph.

Number 8 of the *Cahiers*, under the editorship of Professor André Allix, Rector of the University of Lyons, studies the foreign policy of the United States (*Les fondements de la politique extérieure des États-Unis*, 1949). A brilliant introduction by André Allix on the physical conditions of the settlement is followed by a general study of "American attitudes" by Jacques Lambert and a chapter on American policy in the Pacific by Raymond Guillien.

The relationship between geography and religious beliefs is the subject of a book by Pierre Deffontaines (*Géographie et religions* [*Géographie Humaine*, 21], Gallimard, Paris, 1948). In this useful volume the author gathers the essence of the sociological and ethnographical data relating to mode of life, customs, clothing, housing, eating as determined by beliefs and religious rules. In scope the work is closely attached to ethnography; it deals with material details resulting from myths. Deffontaines seems to have avoided deliberately the study of what religions mean for society's attitude toward nature as a whole and toward neighboring communities, economic activities, and law and order. Although this is a more delicate problem, it is also more significant; for the psychological factor, expressed in a collective attitude, has been the most lasting of social motives commanding migrations, resource development, and political organization. Geographical analysis cannot ignore such motives in human behavior that have helped to differentiate countries and peoples.—JEAN GOTTMANN

COLLECTION OF DEMOGRAPHIC STATISTICS: GEOGRAPHIC COVERAGE.

In 1947 the United Nations Statistical Commission recommended that "demographic data concerning all the countries of the world be assembled and published by the United Nations." The first step toward carrying out this recommendation was the initiation of an investigation, by the questionnaire method, of the current world situation as regards demographic statistics. Forrest E. Linder, chief of the Population and Vital Statistics Section of the United Nations Statistical Office, has recently presented an informal account of the results to date (*A Case Study of the International Collection of Demographic Statistics*, *Milbank Memorial Fund Quart.*, Vol. 27, 1949, pp. 154-178). His article deliberately avoids any evaluation of the quality or comparability of different sets of data and concentrates instead on geographical coverage—whether particular types of information are available for a given country. A series of 11 world maps show that, for the 66.4 per cent of the world's population represented by the governments which replied to the UN inquiry, figures on enumeration are most widely available and are followed by those on age and sex and on vital statistics. These were furnished for 45.7, 42.9, and 39.4 per cent of the world's population respectively. Marital statistics and the data required for fertility analyses are collected by fewer countries, representing only about one-quarter or less of the world's people. As might be expected, China, the Middle East, and much of Africa are conspicuous for their delinquency in collecting material. The United States, which ranks well in most respects, is notably weak in some aspects of its marriage statistics.

During the past century substantial progress has been made in the collection of demographic statistics. Nevertheless, the available data, summarized in this study, do not yet afford a representative picture of world population. This vitiates any attempts at intelligent forecasts of future trends.

Perhaps the strongest point made by Linder is the paradox of a sore need for demographic information along with a scant supply for many categories and areas, whereas in the more materially rewarding fields of industry, commerce, and finance the user of statistics has little to complain about—evidently another example of everyone's business being the direct concern of no one. Demographically, however, the situation is worst where the need is greatest, so that dangerously little is known about nations that are rapidly increasing their numbers. Linder recommends that, in view of the continuing lethargy of many governments, population students take it upon themselves to devise new techniques for probing the demographic situation of poorly known countries and participate as vigorously as possible in nonofficial surveys of world-population size and characteristics.—WILBUR ZELINSKY

GEOGRAPHICAL NEWS

FIRST PAN AMERICAN CONSULTATION ON GEOGRAPHY. The First Pan American Consultation on Geography of the Commission on Geography was held in Rio de Janeiro, September 12 to 24, 1949. This commission and commissions on cartography and history constitute the Pan American Institute of Geography and History. The Commission on Geography consists of one representative from each of the American nations, including Canada. The chairman is Christovam Leite de Castro, the secretary-general Jorge Zarur, both of Brazil. The United States member is Preston E. James; to assist him in matters of professional policy, an Advisory Committee, under the chairmanship of Clarence F. Jones, has been appointed. The delegation to the First Consultation from the United States consisted of four delegates (Preston E. James, chief of delegation, Clarence F. Jones, Samuel W. Boggs, and Arthur Biggs), one adviser (Betty Didcoct), and several observers (Wallace W. Atwood, Jr., Meredith F. Burrill, Otto E. Guthe, Benjamin Lane, Walter W. Ristow, and Colonel Paul C. Schauer).

The Consultation was divided into five committees: physical geography, biogeography, human geography, regional geography, and methodology, teaching, and dissemination. Preston E. James was named president of the Committee on Regional Geography, Samuel W. Boggs vice-president of the Committee on Human Geography. Each committee met three times, first to hear reports from each delegation regarding geographical work in its country, then to discuss geographical problems, and finally to hear the results of field studies and to formulate resolutions.

In addition to the committee meetings, three round-table discussions were held: (1) problems related to the colonization of European small farmers in the tropics, led by Leo Waibel; (2) the contribution of geographers to the study of the conservation of soil and other natural resources, led by William Vogt; and (3) the contribution of geographers to regional planning, led by Clarence F. Jones. The Consultation also included lectures, visits to places of local interest, and official banquets and receptions. After the Consultation there were field trips to three different parts of Brazil.

This first inter-American meeting of professional geographers was of an exploratory nature. In some of the American countries there are no geographers engaged in research and few opportunities for training; in other countries there are active groups of professional

geographers, both in universities and in government agencies. An important geographical research agency is the Conselho Nacional de Geografia in Rio de Janeiro, and Brazil likewise has a large number of first-rate geographers in the universities, chiefly in Rio de Janeiro and São Paulo. Valuable geographical research is also being undertaken in the Argentine Republic, Uruguay, and Mexico. In most of the countries, however, geographical training is handicapped by the separation of physical and human geography, and geographical writing shows the effect of too little field work.

The official results of the Consultation are embodied in 88 resolutions, adopted in the final plenary session. Of these, 66 propose some kind of action and are directed either to the governments of the American nations or to the Commission on Geography. Various delegations and individual delegates with special research interests proposed programs of action in the committee meetings. The proposals were passed on to the coordinating committee, which only slightly reworked and combined them. The coordinating committee made no attempt to establish priorities, in spite of the obvious fact that there are not enough geographers in the whole American hemisphere to undertake even half of this number of research programs.

Several resolutions call for a more effective exchange of geographical publications. One asks that two copies of every new geographical book and periodical be sent to the Institute, one for the Institute library in Mexico, the other for the Commission on Geography, which is made responsible for the preparation of an annual bibliography of geographical writings on the Americas, to be published in the Institute's *Revista Geográfica*. Several resolutions have to do with the teaching of geography in schools and colleges and call for more opportunities for the training of geographers in field methods. The governments are requested to facilitate the exchange of professional geographers and of students. Opportunities for graduate students in the United States to prepare doctoral dissertations on Latin-American areas are to be expanded. One resolution calls for the preparation of a series of regional studies on the American nations, similar in scope to the *Géographie Universelle*.

The United States delegation proposed the organization of a Land Classification and Use Survey of the American hemisphere. The resolution calls first for a chorographic survey of the countries, including the preparation of maps on a scale of about 1 : 1,000,000 showing: (1) physical land types (surface configuration, soil, and water); (2) climate; (3) vegetation; (4) population and settlement; and (5) land use. These maps are to be analyzed for the identification of problem areas for later more detailed study. The survey is intended to provide a background of geographical understanding on which to base plans for the development of underdeveloped areas and the recuperation of areas of poverty. It is to be organized by a committee of experienced field geographers, who will define the categories to be mapped and select areas for pilot studies. It is hoped that this committee will consult with the commission on a world inventory of land use appointed by the International Geographical Union at the Lisbon Congress in 1949.

The Commission on Geography recognized that some kind of priority must be given to the many diverse proposals. Therefore, in reorganizing its committee structure it selected four of the action programs and made each the responsibility of a new committee. The committees are as follows:

Committee on Land Classification and Use Survey

To prepare specific recommendations regarding the development of the survey, the categories to be mapped, the standards to be maintained, and the pilot studies to be undertaken in the immediate future.

Committee on the Geography of the Americas

To formulate plans for the preparation of a series of volumes dealing with the geography of the American countries, with provision for the prompt utilization of the results of the 1950 census.

Committee on Immigration and Colonization

To plan and carry out studies of specific problem areas where geographical methods can furnish an essential basis for the planning of new settlement or the recuperation of older areas.

Committee on Methodology, Teaching, and Dissemination

To promote geographical instruction in all grades, including the advanced training of professional geographers in field methods, and to facilitate the exchange of professional personnel and of texts, maps, and teaching aids.

The Second Consultation on Geography, when these committees will report on their activities, will be held in Santiago, Chile, in 1950, at the time of the General Assembly of the Pan American Institute of Geography and History.—PRESTON E. JAMES

ANNUAL MEETING OF THE NATIONAL COUNCIL OF GEOGRAPHY TEACHERS. The thirty-fifth annual meeting of the National Council of Geography Teachers was held in Cleveland on November 25-26, 1949. General sessions during the two days consisted of (1) discussions of problems in geography teaching; (2) regional reports on Asia, Europe, South Africa, and South America; and (3) a business meeting for members of the Council. Elementary education in geography, the motion picture in geography teaching, and the activities of Gamma Theta Epsilon, honorary geographical fraternity, were the subjects of sectional meetings. Dr. Gilbert Grosvenor, president of the National Geographic Society, delivered the banquet address, "Explorations of the National Geographic Society. With Special Emphasis on the 1949 Nepal Expedition," illustrated with motion pictures in color.

CORRECTION

We have received a letter from Professor Nikolaus Creutzburg, dated October 28, 1949. It reads in part:

"In your issue of October, 1949, of the *Geographical Review*, page 694, my name is mentioned as the 'late Professor Creutzburg.' The title 'late professor' is a bit exaggerated or at least is published too early. I am still alive, and I am occupied with new studies, happy to be productive again and to resume scientific contact, especially with America. I take great interest in the work of American geographers, an interest which has suffered through the total destruction of the Geographical Institute at the University of Freiburg-Breisgau and the inadequate condition of the library."

GEOGRAPHICAL REVIEWS

ECONOMIC GEOGRAPHY OF THE USSR. Edited by S. S. BALZAK, V. F. VASYUTIN, and YA. G. FEIGIN. American edition edited by CHAUNCY D. HARRIS. Translated from the Russian by Robert M. Hankin and Olga Adler Titelbaum. xlv and 620 pp.; maps, bibliogr., indexes. The Macmillan Co., New York, 1949. \$10.00. 8½ x 5½ inches.

The American Council of Learned Societies, under its Russian Translation Project, selected this book as a significant text in the field of economic geography. The Russian edition, published in Moscow early in 1940, was the first part of a two-volume work, of which the second volume (a regional survey) was unfortunately not available for translation.

Students of the philosophy and theory of economic geography will probably be interested in the Soviet ideology contained in the Introduction. Lenin and Stalin are presented as the founders of the Soviet science of economic geography, and "capitalist" geographers, notably Alfred Hettner and Ellsworth Huntington, are attacked intemperately. Throughout the book, in fact, Stalin and Lenin are quoted as leading experts in the field, and quotations from them and from Marx, Engels, and resolutions of Communist party congresses are liberally interspersed.

Chapter 1, "Natural Conditions and Natural Resources of the USSR," is a brief survey of the location, geology, landforms, hydrography, climate, natural vegetation, and mineral deposits of the country. Chapters 2 and 3, "The Distribution of Productive Forces in Tsarist Russia" and "Basic Problems in the Distribution of the Productive Forces of the USSR," present a detailed exposition of the theories of industrial location and economic development before and after the Bolshevik revolution. Chapters 4 through 7 constitute the main informative part of the book, discussing in great detail the areal distribution of population, industry, agriculture, and transportation. The topical breakdown results in separate sections for all the principal commodities and industries; for example, production of aluminum, the furniture industry, confectionery and macaroni industries, rice, peanuts, chicory, and apiculture.

These chapters make up the bulk of the book and correspond to the original Russian edition. They represent without any doubt the most detailed and most accurate account of the economic geography of the USSR available to the English-speaking reader. The text is profusely illustrated with detailed economic maps, the quality of which is exceeded only in the two volumes of the Great Soviet World Atlas. A large number of tables give regional production figures for various commodities as of 1937, one of the last years for which such detailed figures are available.

As has been said, the original Russian edition was published in 1940. In a country such as the Soviet Union, where industrialization is in full swing and where a ruthlessly planned economy alters the face of the land literally overnight, a decade brings immense changes. The decade 1940-1950 saw a considerable part of the European USSR ravaged by war; it saw the construction of a 1000-mile railroad to the sub-Arctic Vorkuta coal basin, the filling of the Rybinsk Reservoir (the largest in the USSR), and the erection of steel mills at Rustavi (Georgian SSR), Temir-Tau (Kazakh SSR), and Begovat (Uzbek SSR), to mention only some of the more imposing works. Lest the reader get the impression that no more up-to-date account of the geography of the USSR can be had, it may be noted that information concerning the current changes in the economy is still forthcoming in spite of

increasingly severe censorship; assiduous and painstaking research in Soviet publications yields bits of data, which can be pieced together to give at least the outstanding details and outlines of current developments.

The translation and editing of the highly specialized and complex text are in general competent. Several problems inherent in the translation of Russian geography texts were satisfactorily solved by means of innovations. An attempt, successful for the most part, was made to reduce all declined adjectival forms to the nominative noun form in which they are most familiar to the American reader. Only in a few isolated cases, such as *Intinsk* instead of *Inta* (p. 466) and *Romensk* instead of *Romny* (p. 443), was this policy overlooked. Political-administrative generics, such as *kray*, *oblast*, *okrug*, and *raion* (*rayon*), indiscriminately translated in the past as "region," "territory," and the like, were correctly considered to be fully Anglicized and were therefore treated as English words.

An attempt was made in the American edition to locate on an appropriate map every place name mentioned in the text. This meant the addition of names to existing maps and the compilation of 19 entirely new maps. However, for lack of room on the maps themselves, many numerical and alphabetical map references were necessary, and this feature as well as the excessive use in the text of parentheses and brackets and parentheses within brackets to introduce explanatory notes makes somewhat cumbersome reading at times.

A further drawback in this reviewer's opinion is the transliteration system, one that is not yet commonly used for Russian place names. This is the American Council of Learned Societies (A.C.L.S.) scheme. Although it is more readable than the reversible system adopted by the United States Board on Geographic Names, it is inconsistent in the transliteration of certain letters in making special provisions for their medial and terminal positions. This superfluous differentiation does not lend itself to place names, for which accuracy and consistency would seem essential. Thus the same diphthong is rendered variously in *Baikal* and *Altay*, merely because of its position. Oversimplification also characterizes the transliteration of other vowel combinations.

A useful feature of the book is the numerous appendixes and indexes prepared especially by the editor for the American edition. These aids comprise a table of equivalent weights and measures; a list of common abbreviations; a transliteration table with three schemes (A.C.L.S., Board on Geographic Names, and Library of Congress); a glossary of Russian terms; a survey of boundary changes 1939-1945, with maps showing administrative divisions, 1913, 1926, 1939, and 1948, and statistical regions, 1937; an index to citations; a short bibliography on the geography of the USSR; and indexes of persons (with biographical notes), plants and animals, and place names appearing in the text and on the maps.

With few exceptions, the indexes, maps, and text are remarkably free from typographical and other misspellings, in spite of the complexity of the place names. Name changes that have occurred since the publication of the Russian edition are frequently entered in brackets. The few misspelled names are generally identifiable, except, for instance, the paper-milling center of *Lopatino* in the Mari ASSR, which appears as *Dopatino*.

In summary, then, it would seem that although the book offers little new material to the close student of Soviet geography, it will serve the nonspecialist as a useful introduction to the subject in spite of the ideological overtones. Because of its out-of-dateness, however, it should be supplemented ultimately by an account of the wartime and postwar changes in the economic geography of the USSR.—THEODORE SHABAD

ANTARCTIC CONQUEST: The Story of the Ronne Expedition 1946-1948. By FINN RONNE. xx and 299 pp.; maps, ills., index. G. P. Putnam's Sons, New York, 1949. \$5.00. 8½ x 5½ inches.

The qualifications for the successful explorer were briefly examined in a recent issue of the *Geographical Review* ("Explorers: Men and Motives," July, 1948), and the same issue carried an example of successful exploration, the "Ronne Antarctic Research Expedition 1946-1948." This was a preliminary account, a first draft prepared in the field and flown to the Society from Valparaiso. Immediately on the expedition's return, work was begun on the scientific reports, and these are in process of publication by the Office of Naval Research and other authorities. Now the story of the expedition appears as "Antarctic Conquest." If the expedition itself was a model undertaking, so is the book a model presentation—forthright, incisive, illumined with touches of humor and with the underlying feeling for the wilderness that bespeaks the true explorer. The main geographical objective—the definition of the southern part of the Palmer Peninsula and its connection with the eastern shore of the Weddell Sea—and the aims of the ancillary investigations are clearly stated. Methods of accomplishing them are described with enlivening detail; for example, the discussion of pemmican and its use on sledge expeditions, in which Ronne is a firm believer.

Besides being a book for the general reader, this is a book for the explorer in any field of investigation. The heart of the matter is explained in the foreword, by Isaiah Bowman: "The first condition of high achievement is thorough preparation. The second is painstaking and resourceful execution when the inevitable difficulties and opportunities arise. The third is perseverance. If to these three ingredients is added a touch of genius, the result is uncommon, and the man who achieves it is preeminent." And, continuing: "We judge expeditionary leadership in terms of scientific results. With but fifty thousand dollars, plus government equipment, the Ronne Antarctic Research Expedition of 1947 [date of sailing January 25]–1948 was able to return with a harvest of scientific findings that would be a credit to a far more costly expedition. . . . The expedition delivered to the Air Force 14,000 trimetrogon photographs, probably 75 per cent of which are effective for mapping purposes. . . . They photographed 750,000 square miles, of which 250,000 . . . was newly explored territory. . . . As a necessary part of the photography, ground control was attained by an ingenious 'leap-frog' method of aerial advance. This involved 86 landings in the field, half of them without a ground crew."

In the chapter "What We Accomplished" (pp. 255-268) Ronne adds some details to the two-page synopsis in the *Geographical Review* and whets the scientific appetite with his references to such work as the seismological studies, which included the correlation of microseisms with changes in weather, the upper-air observations ("the stratosphere virtually disappears in Antarctica"), the drastically different measurement of solar radiation, studies of the little-known Antarctic tides. Geological reports are promised, in cooperation with the Geological Society of America. The book includes 52 photographs and, in addition to the maps reproduced from the *Geographical Review*, two others, one of the Antarctic Continent and the other of the central part of the Palmer Peninsula, drawn by William Briesemeister of the Society's staff.

"Antarctic Conquest" is exciting reading, for its adventures of course, but even more for the triumphs of skill and management that prevented adventures and were an essential part of the "conquest." Ronne dwells on the necessity for punctilious attention to the routine

duties of the day, the "tiresome precaution that the Antarctic demands from those who would stay alive in it." Modern exploration is an extremely complicated business, calling for a vast range of observations and complex apparatus that must be used with "care and foresight." Moreover, one is "never certain how equipment will behave in Antarctic temperatures until tried out." One of the functions of the expedition was the testing of equipment for the Quartermaster Corps of the Army.

The importance of *matériel* performance is more than matched by that of the *personnel*. In the Antarctic human relations are put to the crucial test. The aggressive, adventurous, unconventional individualist who in particular is attracted to exploration is not the easiest to get along with; difficulties must be expected, but the successful expedition "is not one that has no personality troubles . . . but one that gets what it went after in spite of such human failings." To justify the effort, a modern Antarctic expedition must have a considerable personnel, and in some respects the very large, government-supported expedition has advantages, though it lacks the freedom and flexibility of the private organization. "I consider myself lucky to have carried off what may have been one of the last large-scale explorations on a private basis," says Ronne. With government participation in Antarctic exploration the political aspect looms large. This proved no handicap to the Ronne expedition, and it is pleasant to record the friendly and mutually helpful relations with the British Falkland Islands Dependencies Survey party, also stationed in Marguerite Bay. It was the British doctor who descended the crevasse in the epic rescue of Peterson, Ronne's physicist; it was the Americans who rescued the British fliers. The joint British-American sledge journey on the Weddell Coast was a notable piece of cooperation.

HANDBOOK ON THE TRUST TERRITORY OF THE PACIFIC ISLANDS. Prepared by the Office of the Chief of Naval Operations, Navy Department, 1948. viii and 311 pp.; map, ill., bibliogr. U. S. Government Printing Office, 1949. \$1.50. 10¹/₂ x 8 inches.

This review is being written at a time when a change in administration is impending in the islands of the United States Trust Territory. The Navy has been directed to turn over the reins of government to the Department of the Interior. The shift will begin in July, 1950, but it may be a year or two before it is completed. Changes of this sort are nothing new to the natives of the Trust Territory; missionaries, Spaniards, Germans, Japanese, and the American Navy in turn have ruled these islands. To the natives the United States civil administrators will be merely another in a long series of "bossmen."

The Navy Department's handbook treats the Territory as it has been under naval administration. Unlike the Civil Affairs Handbooks that preceded it, the book lays stress on conditions in the postwar period and draws largely on the considerable body of new materials that has resulted from investigations carried on during that time. Unfortunately, however, most of the results of the CIMA program, the most ambitious postwar research effort undertaken in Micronesia, were not yet available at the time the handbook was prepared.

In a general view of the book two features are especially apparent. One is the considerable emphasis on such topics as administration, health and sanitation, and education. Although this emphasis may be unfortunate from the viewpoint of the general reader, it is in line with the stated purpose of the handbook, which was written chiefly as "a training manual for civil administration personnel."

The second feature, and perhaps the most notable part of the book, is its strong treat-

ment of native cultures. This is not as inconsistent with the major purpose as it might at first thought appear to be. The experience of American forces in the Pacific demonstrated early the absolute necessity for an understanding of native peoples if they were to be dealt with on any but the most arbitrary terms. It is not surprising, therefore, that anthropology plays an important role in the handbook. Local customs, clan systems, native etiquette and ceremony, and similar matters are given extended treatment. Indeed, although the fact is not mentioned, an anthropologist, Felix M. Keesing, supervised the preparation of the book and also wrote several of the chapters.

In the chapter on population a contrast is brought out that is especially important in the geography of American Micronesia. The "high islands" suffered a long period of population decrease after their discovery by the white man. The trend was recently reversed, but the islands are still by no means densely peopled. Many of the atolls, on the other hand, are so heavily populated that they are coming to be recognized as the real problem areas, not only of the Trust Territory, but of the whole South Pacific.

The chapter on "land and labor" brings into focus a subject that ranks with overpopulation of the atolls as an official headache. From the very first, American occupation forces have been faced with the necessity of unsnarling the landownership picture in American Micronesia. Even on the atolls the pattern of ownership is complex and controversies many; on the larger islands the problem has been further complicated, in many instances, by the question whether land sales to the Japanese were voluntary or forced. And on both "high islands" and atolls the solution of landownership problems is intimately tied to local customs. It is a situation in which anthropologist and geographer might well work side by side.

Of particular interest to geographers are the chapters dealing with "island setting" and "resources and their utilization." The first treats briefly the physical geography of the islands; the second makes clear the primary importance of agriculture and the secondary, though highly significant, role of marine resources. With respect to land use, it is noteworthy that commercial agriculture reached its peak under the Japanese and is now much less important. It may rise again, especially on the larger islands; for the atolls the norm appears to be an agriculture that is largely devoted to subsistence crops with a side line of copra for export. —
RAYMOND E. MURPHY

TRUSTEESHIP IN THE PACIFIC. Edited by A. H. McDONALD. xi and 171 pp.; index.

Published under the auspices of the Australian Institute of International Affairs and the Institute of Pacific Relations. Angus & Robertson, Sydney and London (obtainable in the United States from P. D. and Ione Perkins, 1603 Hope St., South Pasadena, Calif.), 1949. 10s. 6d. 8½ x 5½ inches.

This book was written by a study group of the Australian Institute of International Affairs. The work has been done skillfully, and the result is a readable and fact-filled book containing many intelligent observations on colonial affairs. The title is too modest: the real scope is colonial policy in the Pacific and Asiatic realms.

The general outlook of the authors is realistic. They are under no delusions about the real power of the Trusteeship Council or the disinterestedness of the trustee states. Nevertheless, they are by no means pessimistic and can point to the progressive liberation of colonial areas as proof that realism is not necessarily incompatible with idealism. The book is notably objective. Not only do the Australian authors freely criticize their own government's policies

in New Guinea, but, more remarkable in this polarized period, they maintain a highly objective attitude toward the United States. American policy in the Philippines is both praised and blamed, as befits our dichotomous handling of the political and economic aspects of independence. The lesson of the Wilson-Harrison "Filipinization" experiment is succinctly drawn. The Bell Act of 1946 is pointedly criticized. (Incidentally, Osmeña is spelled Osmerna throughout the chapter on the Philippines.)

The plan of the book proceeds from the evolution of the trusteeship idea to the *Realpolitik* by which the idea was converted into mechanism. Examples of trusteeship in colonial government in practice are then examined—New Guinea, Nauru, Western Samoa, Micronesia, and the Philippines. The Philippines are considered a case of trusteeship in principle, though of course never held as such under any international body. The last three chapters deal with colonial conditions in the region under consideration, with political development, and with regionalism. The effect is, unfortunately, anticlimactic. The earlier chapters are the more fully developed; the later ones tend to be sketchy and, in short, are not the well-wrought systematic treatments that the table of contents seems to promise.

The book requires some background of knowledge of the lands it covers. The authors have not tried to write a Pacific primer for the totally uninformed. Attention centers on the events on the political and economic surface rather than on movements in the social substratum. The book should be most useful to those who have a long-standing interest in, but not a specialist's knowledge of, the topics and regions covered.—STEPHEN B. JONES

OIL! TITAN OF THE SOUTHWEST. By CARL COKE RISTER. xxiii and 467 pp ; maps, diags., ill., bibliogr., index. University of Oklahoma Press, Norman, 1949. \$5.00. 9¼ x 6¼ inches.

The all-pervasive role of oil in our modern economy hardly requires emphasis, yet the complex story of the discovery and development of the mid-continent and Gulf Coast fields, which produce about three-fourths of the United States petroleum supply, has been so neglected as to constitute a major gap in historical and regional writing. Most of the chapters in this narrative description are concerned with one or more of the great commercial oil fields of the Southwest, from Neodesha (1892), Corsicana (1896), and Spindletop (1901) to the recent Permian Basin discoveries and deep-drilled wells along the Texas and Louisiana Gulf Coast. The American oil industry's remarkable and sustained success in prospecting for new fields, as E. L. DeGolyer remarks in the foreword, is peculiarly the product of multiple individual effort. In tracking down individual case histories, Professor Rister has drawn from an impressive array of original source materials and interviews with many of the men who have had a hand in the making of oil history. In so complex and rapidly changing an industry the facts crowd on one another in embarrassing numbers, and it is understandable that the trail is occasionally lost among personalities, lease descriptions, and statistics. The historical geography of Southwestern oil fields, pipe lines, and refineries is incredibly intricate (there are more than 1200 separately recognized producing oil fields in Texas alone), and unfortunately the map is not one of the author's effective tools.

The histories are recounted of most of the great shallow pools that rose meteorically to production peaks and declined almost as rapidly to become low-yielding "stripper" fields. Profligate waste of gas and consequent disastrous decline in field pressure form a recurrent theme, though some fields, such as Spindletop, Electra, Conroe, Humble, Yates, and Big

Lake, have experienced one or more revivals with the use of deeper drilling and improved recovery techniques. The opening of the mammoth East Texas and Oklahoma City oil fields in 1930 led to crystallization of state conservation and proration laws that today effectively eliminate most oil-field waste and at the same time guarantee an orderly price structure to the industry by tying production allowables to market demand. The detailed statistical summary of yearly production of major Southwestern oil fields reveals the uncontested dominance of the prolific East Texas field during the past two decades despite the unparalleled orgy of overproduction in the early thirties, when field output reached a peak of 900,000 barrels daily. East Texas production is still nearly four times that of the second-place Panhandle field, though natural gas piped from the latter to markets as far away as Detroit, Minneapolis, and Los Angeles gives it a significance of its own.

This pioneer study was financed by a research grant from the Standard Oil Company of New Jersey to the University of Oklahoma Foundation. It is a reassuring indication of the oil industry's maturity that it is showing such signs of serious interest in its recent history.

—JAMES J. PARSONS

AGRICULTURE IN THE SUDAN: Being a Handbook of Agriculture as Practised in the Anglo-Egyptian Sudan. Edited by J. D. TOTHILL. xviii and 974 pp.; maps, diagrs., ills., bibliogrs., index. Oxford University Press, London, 1948. 42s. 8³/₄ x 5¹/₂ inches.

Most of the contributions to this symposium were written under the stress of war (1941–1945), mainly during occasional holidays or at odd moments snatched from more urgent duties. Of the competence of the 28 authors there can be no doubt. Their official positions run the gamut of government appointments, and their years of service in the Sudan have made them intimate with both the country and its problems.

The 31 chapters are grouped into three parts. The first deals with such general topics as climate, geology, soils, and transport. Here the reader can judge for himself how slight the basic information is on which the formulation of all plans to further the agriculture of the Sudan must rest. Weather stations are widely spaced, a comprehensive soil survey non-existent, and as for geology, "interpretation of facts has depended very largely on published contributions from contiguous countries." Certain serious problems are discussed, such as land fractionation in the conservative Moslem north, where the laws of equal inheritance, coupled with the population increase attendant on the peaceful years of condominium rule, have resulted in many landholdings, each too small to support a family. There is also the difficulty of evolving a system of education that will enable an educated native to make a contribution to, not estrange him from, his tribe.

The second part, dealing with agriculture and farm animals, considers the more technical aspects of agriculture, such as research, crops, weeds, and animal foodstuffs. Those concerned with tropical agronomy will find Chapter 20, "A Review of Experimental Work," by the late Frank Crowther, an excellent summary of what has been done in tropical and sub-tropical agriculture in the Sudan. To the geographer, the chapter on irrigation, by W. N. Allan and R. J. Smith, will be of particular interest.

The third part, on "province agriculture," considers the Sudan regionally. A breakdown into political units is usually not too satisfactory, but here it works fairly well, since with a single exception, Kassala, the provinces roughly coincide with what would probably be recognized as natural regions.

No book of this size and scope is without omissions and infelicities. In this particular volume, however, they are far outweighed by the general excellence. As in most symposia, there is no well-expressed central theme to give coherence. Nowhere is this more evident than in the handling of soils. That soils are important in any treatise on agriculture is axiomatic, but that the reader gains a clearer picture when they are treated first with geology and then in two succeeding chapters is questionable. To the reviewer the chapter on climate seemed one of the less well presented ones. The author sketches in broad outline the air masses that flow over the Sudan but fails to make clear the part played in the rainfall regimen by the individual masses. Perhaps this lack of clarity results from the attempt to explain in nontechnical terms, and briefly; a meteorological explanation in simple terms is often difficult.

Three omissions are important. There is almost no consideration of soil erosion, though in many parts of the Sudan it is a serious problem. The omission was intentional, "because the whole subject was recently reviewed by the Soil Conservation Committee, the report of which was published in 1944." But a summary at least, in the chapters on province agriculture, would have been helpful. It is unfortunate that the book went to press too early to discuss the controversial subject of the *hafirat* (artificial pools) being built by the government near the part of the country crossed by the 20-inch isohyet. That *hafirat* yield drinking water of dubious quality is true; nonetheless, they are likely to have a far-reaching effect in a region of marginal rain cultivation. Chapter 11, "Revenue from Land and Crops," would probably have been improved had a complete picture of state revenue been presented. For example, in 1942 roughly 11 per cent of the national budgetary revenue was derived from railroad profits, in turn largely attributable to the hauling of agricultural produce, especially cotton. Yet this, together with the increased import duties and sugar sales, is dismissed in three sentences.

These criticisms, however, point out but slight blemishes in an excellent work. In general the material is presented with great clarity and with a wealth of detail reduced to tabular form. The illustrations are numerous and well chosen. The maps, originally produced by the Survey Department, although simple are clear and well executed. Unfortunately, however, the volume is printed on very thin paper, and as a result the print from the other side of the page is annoyingly visible and half tones lose detail. There is a carefully selected bibliography of 22 pages, and it is supplemented by shorter bibliographies appended to individual chapters. The "Glossary of Arabic and Vernacular Words" is most helpful. This is a book that makes a real contribution to our knowledge of Africa and will become a "must" in the reading of those who wish to learn something of this part of the world. - H. THOMPSON STRAW

LES FONDEMENTS DE LA GÉOGRAPHIE HUMAINE. Volume 2, Les fondements techniques, Part 1. By MAXIMILIEN SORRE. 608 pp.; maps, diags., bibliogr. Librairie Armand Colin, Paris, 1948. 1100 fr. 10 x 6½ inches.

Following an earlier volume (*Les fondements biologiques de la géographie humaine*, 1943), Professor Sorre carries on his monumental work on the foundations of human geography with the study of techniques and their impact on the relationship of man and matter. The present volume does not exhaust this broad subject, especially as the author uses *techniques* in the widest sense and outlines their consequences for the social, economic, and political organization of mankind. The first section of the book covers the techniques of the organization of

society, from primitive clans to modern states and empires; the second is devoted to the use of energy; and the third, entitled "The Conquest of Space," deals with transportation and communication. Raw materials and the techniques of their production and transformation will be considered in more detail in part 2, now in preparation.

In a previous article ("French Geography in Wartime," *Geogr. Rev.*, Vol. 36, 1946, pp. 80-91) this reviewer cited Professor Sorre's "Biological Foundations" as an example of the crowning works produced in the 1940's by the generation of Vidal de la Blache's students. This new volume is of the same quality—an all-embracing essay that sums up with great impartiality and serenity some of the conclusions of Sorre's lifework. Its usefulness is increased by the scope of the author's idea of what could be termed "geographical causality"; facts are presented here in their double geographical framework—natural or physical conditions on the one hand and human or cultural elements on the other.

In his introduction Professor Sorre mentions man's hope of final emancipation from the material realm through technical improvement, especially in the field of transportation, adding that such a hope is a mere illusion. One wishes for more details as to the extent to which the "conquest of space" does liberate man. The process may perhaps be brought down to a struggle against the natural odds as well as against the pressing weight of our own background of beliefs and vested interests. In this connection, this reviewer hopes to read some day a comparative examination by Professor Sorre of Ruth Benedict's notion of "patterns of culture" and Vidal de la Blache's classic "genre de vie." It would be most interesting also to see a discussion of Arnold Toynbee's method of classifying civilizations with respect to the "environmental challenge."

However, one must recognize that an all-embracing work, precisely because it is such, cannot discuss everything. And the author has several more volumes now in the making to complete his most useful series.—JEAN GOTTMANN

THE CARTA MARINA OF OLAUS MAGNUS, Venice 1539 & Rome 1572. By EDWARD LYNAM. vii and 40 pp.; maps. (Tall Tree Library Publ. 12.) Tall Tree Library, Jenkintown, 1949. \$6.00. 10¼ x 7 inches.

In 1539, Olaus Magnus, a Swedish scholar and Catholic ecclesiastic in exile in Italy, produced a map of northern Europe, "which it is still a delight to peruse." Dr. Edward Lynam of the British Museum has done a major service to the history of cartography and exploration by giving us the first full description in English of this magnificent sixteenth-century "Carta Marina."

Through his duties with the Catholic Church, and on political and commercial missions in the service of the Swedish king, Olaus Magnus traveled extensively in Scandinavia and visited the thriving towns around the Baltic and North Seas. Imbued with ardent patriotism and an inexhaustible curiosity regarding places and people, he collected a vast amount of material on local history and geography, folklore, and industries. Work on the map was begun in 1527 in Danzig. In 1535 Olaus removed to Venice, and here, "through the generous assistance" of the Patriarch of the Republic, Hieronimo Quirino, the map was published in March, 1539, with the title "Carta marina et Descriptio septemtrionalium terrarum ac mirabilium rerum in eis contentarum, diligentissime elaborata Anno Domini 1539 Veneciis liberalitate Reverendissimi Domini Ieronimi Quirini." It was in nine sheets, printed from wooden blocks engraved in high relief, with an overall measurement of about 5 feet 6 inches

by 4 feet—the largest engraved map produced up to that time, and on the largest scale yet used except for town plans.

Its very size made the map expensive to produce and difficult to preserve. It is not known how many copies were printed, but by 1572 very few were in circulation, and by the end of the sixteenth century all trace of the *Carta Marina* had disappeared. It was not until 1886 that a copy was discovered, in the Hof- und Staats-Bibliothek at Munich.

In 1572, Antonio Lafreri of Rome published a reproduction of the *Carta Marina*, and it is owing to this reproduction that knowledge of Olaus' map persisted through the centuries. Lafreri's reproduction is not an exact facsimile, having been reduced and engraved on copper in two sheets, with many changes in lettering and illustrations. Of the seven copies known to exist, two are in America, one in the Library of Congress, the other in the library of Mr. George H. Beans of Jenkintown, Pa.

Dr. Lynam's monograph opens with a discussion of the need for better maps of Scandinavia at the beginning of the sixteenth century and a sketch of the early life of Olaus Magnus, then proceeds to a detailed analysis and description of the *Carta Marina*, its construction, sources, and illustrations, and finally gives an account of the Lafreri reproduction and of the changes in cartographic styles and in lettering, 1539 and 1572, and the influence of both maps on map making. A reduction of the *Carta Marina* and a reproduction of Lafreri's map of 1572 accompany the book, and the many illustrations in the text are taken from the Lafreri map, on the original scale.

It is a great advantage to be able to compare the two editions of this fascinating map, and to examine the many details brought out by Dr. Lynam's scholarly study. The illustrations are superbly reproduced, and the Anthoensen Press of Portland, Maine, is to be congratulated on its craftsmanship.

CONURBATION: A Planning Survey of Birmingham and the Black Country. By the West Midland Group [on Post-war Reconstruction and Planning]. 288 pp.; maps, diagrs., ills., index. The Architectural Press, London, 1948. 30s. 11½ x 8½ inches.

The main objectives of this excellent report are "the assembly of facts and figures collected on the spot, and the examination of those bases on which the good life may be securely founded in the Conurbation area." The "conurbation" is defined as the continuous urbanized area that contains the city of Birmingham and the group of smaller towns on its west side known as the Black Country. The whole area covers 270 square miles and has a population of more than two million. Its history and its present social and economic structure afford a clear picture of the character of other great urban areas of Britain.

In this review little more can be done than enumerate the contents of the work. The sequence of chapters is as follows: Historical Sketch, Physical Background, Local Government, Communications, Population, Housing, A Survey of Industry, A Survey of Factory Buildings, Smoke Pollution, Surface Utilisation, Land Classification around the Conurbation, Redevelopment within the Green Setting, Two Schemes of Redevelopment, Summary and Conclusions, and an appendix on the South Staffordshire and Cannock Chase Coalfields.

Two hundred years ago the industries of the area were based on local coal and iron. Mine, quarry, slag heap, forge, and furnace along canal and railroad were the main expressions of this era and have left their legacy in the form of derelict land and urban sprawl in the Black Country. Birmingham developed a variety of fabricating industries—brass and copper

wares, jewelry, guns, buttons and pens, screws and wires, and others. This era reached its peak in the seventies. Coal mining, iron smelting, the manufacture of wrought iron, and many branches of hardware production then declined, and the whole area became increasingly dependent on imported raw materials. A wide range of new industries developed that used steel instead of wrought iron. Some of the old industries survived, such as jewelry making; others, such as the making of hand-wrought nails, disappeared. The new industries were the cycle and automobile trades, the electrical and artificial-silk industries. Thus with a wider and more diversified industrial base the conurbation did not suffer so much as other industrial areas during the interwar depression. Indeed, it became prosperous during the thirties and, like London, increased its population by immigration well above the average for the country as a whole. Many traits of the conurbation arise from this special industrial character.

Particular attention may be drawn to the analysis of industry prepared by a committee under the chairmanship of Professor P. Sargant Florence. The great diversity of industries is analyzed on the basis of Sargant Florence's "Location Quotient" in order to determine both the distinctive industries of the conurbation and the distribution of industries within it. Seventeen industries were found to be distinctive, and these are subjected to a penetrating analysis in terms of the Ministry of Labour employment figures, the population census, and the production census. In a study of local government, the relation of boundaries to the land-use areas is examined (with maps), and the Group favors four or five all-purpose authorities in place of the 24 existing local authorities. Houses and factories were surveyed as to condition, and it is concluded that one-third of the houses should be replaced as soon as possible. The factory survey classes the factories as (1) bad and ready for demolition; (2) moderate, i.e. ready for demolition within 30 years; and (3) good. Demographic trends are examined with care, and of particular importance is the finding that the social services are 15 to 50 per cent below the average for the country as a whole. Thus more shopping centers, hotels, restaurants, civic buildings, community centers, theaters, and concert halls are urgently needed.

Much of the report is based on the existing pattern of land use. The whole conurbation was surveyed on the scale of six inches to one mile with the land use shown in eight categories: open space; undeveloped; derelict; industrial; residential; commercial; administrative, health, educational, and public services; and transport. Two sheets of the 64 are reproduced on a reduced scale. There are also general maps, based on this survey, on the scale of $2\frac{1}{2}$ miles to one inch, showing the distribution of open land (undeveloped, derelict, and open spaces), communications and industry, and housing and the main shopping centers. A series of maps of one district, Smethwick, show the major categories of land use. An important conclusion of this survey is that undeveloped land covers more than half of the total area, and more than one-tenth of the Black Country is classed as derelict. It is suggested that there is adequate room in the area for redevelopment by the control of future building and by the redevelopment of the urban nuclei. The agricultural possibilities of the lands around the conurbation are also mapped so as to suggest the lines of future urban expansion. The report concludes with special planning proposals for the future landscape development of a derelict area and for the development of a market-gardening area into which suburban growth has expanded to the detriment of the agricultural pattern.

The volume is outstanding for its colored maps, diagrams, and photographs. Sets of

photographs show the general character of the conurbation, industrial life in the nineteenth century (from contemporary engravings), housing and factories, surface use, derelict land and playground areas, the Black Country scene, and coal mining. Particularly interesting is a group of 48 photographs taken from the window of a railroad train between Birmingham and Wolverhampton.

The work is a masterpiece of the new spirit of cooperative research that pervades the whole field of urban and rural survey in Britain. It is a cross section of urban Britain. It provides an attractive and readable statement of the facts of the Midland conurbation upon which its future planning should be based. The book was designed to reach a wide public so as to help build an informed opinion on the facts relevant to planning. It should be read and reread by all who are interested in the character of urban Britain, the techniques of urban survey, and the problems of planning town and countryside. --ROBERT E. DICKINSON

VAHLS KLIMAINDELING: En Redegørelse. By JOHANNES REUMERT. Maps. *Geogr. Tidsskrift*, Vol. 48, 1946-1947, pp. 184-221.

VAHL'S CLIMATIC DIVISIONS: An Explanation. By JOHANNES REUMERT. Maps. *Ibid.*, pp. 222-253.

In these two articles, Johannes Reumert bids for general acceptance, particularly in teaching, of the classification of climates worked out by his teacher and colleague Martin Vahl (1860-1946), in place of the classifications now in use; hence his publication of the full text in a language more widely read than Danish. Such a special article is needed because Vahl in his lifetime did not provide a complete exposition of the system he elaborated in scattered publications.

Reumert's presentation is therefore an act of piety toward the memory of a beloved teacher, and his claims for Vahl's classification are probably higher than its author himself would have made. Vahl's approach to the problem of a classification of climates was that made familiar by Köppen and later followed by Thornthwaite: to find values of observed climatic "elements" (better, functions of those "elements") that coincide with boundaries of vegetational regions. His approach was, however, from the direction of vegetation rather than from that of climate: he sought to explain the distribution of vegetational formations rather than to find a procedure by which the distribution of climatic complexes might be systematized. One must agree with Reumert to the extent of regretting that Vahl's contributions did not enter into the long debate over the classification of climates that seems now, from our viewpoint, to be slackening. Vahl's discussion of climate as such never progressed far beyond Köppen's of 1900 and was scarcely affected by Köppen's writings of 1918 and later years. Against the background that Thornthwaite has given us since 1931, Vahl's ideas concerning climate seem to belong to the age of the top hat and the Prince Albert coat.

This notice cannot attempt a detailed criticism of Vahl's system. However, in view of Reumert's bold challenge to Köppen and Thornthwaite, it would be worth while for someone to test Vahl's definitions by applying them to North America, the proving ground for many of Köppen's proposals. Reumert gives (pp. 186-187 and 224-225) an outline of the numerical definitions of Vahl's boundaries of vegetational regions, so far as Vahl provided such definitions. This outline makes a good starting point for a test.

The maps accompanying Reumert's article are maps of vegetation rather than of climate.

One extremely useful service they perform is to call attention to a wall map of the earth showing Vahl's "Climatic and Vegetation Zones" (actually vegetational zones) on Eckert's sixth projection, scale 1 : 25,000,000, published by the Danish Geodetic Institute, Copenhagen, which is reproduced in color on one-fifth the scale of the original. The map bears legends in English, French, and Danish and would be a valuable addition to any collection of wall maps.—JOHN LEIGHTLY

HANDBOOK OF SOUTH AMERICAN INDIANS. JULIAN H. STEWARD, editor. Prepared in Cooperation with the United States Department of State as a Project of the Interdepartmental Committee on Scientific and Cultural Cooperation. Vol. 3, The Tropical Forest Tribes, xxvi and 986 pp.; maps, ills., bibliogr. Vol. 4, The Circum-Caribbean Tribes, xx and 609 pp.; maps, ills., bibliogr. Vol. 5, The Comparative Ethnology of South American Indians, xxvi and 818 pp.; maps, ills., bibliogr. *Bur. of Amer. Ethnology Bull.* 143, 1948-1949. Vol. 3, \$4.50; Vol. 4, \$3.50; Vol. 5, \$3.00 (all obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.). 9¼ x 6 inches.

The review of the two earlier volumes of the "Handbook of South American Indians" that appeared in these pages in 1947 (*Geogr. Rev.*, Vol. 37, pp. 332-334) contains information about the organization of the work. As was mentioned in that review, the original plan called for five volumes. This has now been changed. The material reserved for Volume 5 grew to such proportions that it seemed advisable, both for convenience and because of budgetary limitations, to split it up and bring out a sixth volume. This volume, now in press, will be entitled "Physical Anthropology, Linguistics, and Cultural Geography of South American Indians."

Volumes 3 and 4 follow the previously established pattern. Each is introduced by a map showing the areas of South America covered in the respective volumes. This is followed by a general article giving a broad picture of the particular area; then the tribes of the areal subdivisions are treated individually. Although the treatment of sections is irregular on account of the varying amount of data available, both the known archeologic background and the ethnographic picture from the time of first contact are summarized.

Of the 38 contributors to the new volumes, only five appear in more than one: Julian H. Steward, Paul Kirchhoff, and Alfred Métraux in all three; Robert H. Lowie and Irving Rouse in two.

Carrying the lead in the 40 articles of Volume 3 are Métraux and the late Curt Nimuendajú, each of whom contributed alone or with a coauthor 11 articles. The tribal maps compiled by Nimuendajú are noteworthy. It is safe to say that without his assistance much of the information about the forest tribes of Brazil could not have been so accurately summarized. Also, without this stimulus for writing, doubtless Nimuendajú's personal knowledge would not have been recorded.

Volume 4 presented the greatest editorial problem, because "the ethnology [of the circum-Caribbean area] is known mainly from fairly recent studies of the few extremely deculturated tribes who remain and . . . [because] the archeology has not been linked to the historic peoples except in a few instances." This paucity of information made it difficult to find contributors prepared to write on the subjects to be covered. Nevertheless, the results prove that the effort was worth while.

Of the 37 articles in Volume 4, Kirchhoff, Gregorio Hernández de Alba, Frederick Johnson, and W. Duncan Strong are the main contributors. They are also largely responsible for the maps.

Volume 5, like the final volume to come, departs from the plan described above. It contains topical, comparative, and distributional articles dealing with the whole of South America. Such summary articles had to be limited, naturally, to subjects on which sufficient information was available and for which qualified writers could be found. The omissions, however regrettable, will serve to direct future research.

Of the 31 articles in Volume 5, the most frequent contributors are Wendell C. Bennett, the late John M. Cooper, and Métraux. Especially noteworthy, however, are the following articles by single contributors: "Basketry" and "Weaving," by the late Lila M. O'Neale; "Ceramics," by Gordon R. Willey; "Metallurgy," by William C. Root; "Art," by Alfred L. Kroeber; and "Medical Practices," by Erwin H. Ackerknecht.

As in the earlier volumes, the fullness of the bibliographies is a useful feature. In the three volumes under review the combined references occupy 150 pages. The bulk of this bibliography gives some idea of the editorial work required in systematizing and checking.

Large though it is, the bibliography has of course been but one part of an enormous task. In retrospect the work of arranging details with contributors all over the hemisphere—subject coverage, style, illustrations, translation, editing, proofreading—is indeed formidable. Dr. Steward, the editor, deserves great applause simply for organizing the project, let alone carrying out the multitudinous editorial duties and contributing important articles. Considering the scarcity of authorities on South American anthropology and the inaccessibility of many of the published sources, it is amazing that so much information has been compiled and that such high editorial standards have been maintained.

In view of the great effort that has already gone into the Handbook, and its importance as a research tool, both the editor and the sponsoring institutions are strangely evasive about such rumored future additions as the index, the tribal synonymy, and the consolidated bibliography. Without these all-important and scholarly guides to, and summations of, six such bulky volumes, everyone involved will have left his task unfinished. Unfortunately, now that Dr. Steward has left the Smithsonian, he is no longer available to promote and direct such things. And unless there is sufficient demand from users of the Handbook, these further aids to research may not soon be supplied.—T. D. STEWART

MAPS: Their Care, Repair and Preservation in Libraries. By CLARA EGLI LEGEAR. ix and 46 pp.; ill., bibliogr. Library of Congress, Washington, 1949. 10¼ x 7½ inches.

Libraries and other institutions will feel less discouraged about the peculiar problems presented by a map collection if they will read this short work by an experienced member of the staff of the Library of Congress. Mrs. LeGear says, quite rightly, that maps will repay all the care a library can give them, even though filing equipment is bulky and often expensive. She gives explicit instructions on handling maps from the time they arrive. Routine processing, filing, and mounting and repair are all discussed, and the practice and experience of several large map libraries are cited. Materials and equipment are described in detail. The special problems presented by globes, relief models, and atlases in their baffling array of sizes are also considered, and useful advice is given. The publication closes with a bibliography of the literature written since 1857. With so much experience to build on, maps should never again be the library's "forgotten man."

AGRARIAN UNREST IN SOUTHEAST ASIA. By ERICH H. JACOBY. xvii and 287 pp.; maps, bibliogr., index. Columbia University Press, New York, 1949. \$4.00. 9¼ x 6 inches.

The rapid advance of the Chinese Communists in their southward drive into the provinces of Kwangtung and Fukien and other recent postwar developments have forced the West to become increasingly concerned with Southeast Asia. This region is striving to free itself from alien economic and political domination, and, in the political sphere at least, it has made remarkable headway. Western economic and political penetration has failed to further the material welfare of the rural masses and instead has caused a disintegration in rural communities, leading to serious difficulties and widespread discontent among the peasant peoples.

Dr. Jacoby interprets "agrarian unrest" broadly and therefore includes in his survey Burma, Siam, Indochina, Malaya, Java, and the Philippines. The first and last chapters deal with themes common to all the countries of Southeast Asia, such as the effect of Western penetration on the economic and social structure of the village, the role of the Chinese and Indian moneylender and middleman, the growth of commercial agriculture, the deplorably low levels of living, health, and education, and the growth of national movements. The other six chapters are devoted each to one specific country and cover such topics as population, area under cultivation, size of farms, land tenure, rural indebtedness, levels of living, attempts of the government to improve conditions of the rural population, and, where they have occurred, peasant uprisings.

The book does not offer anything new, since it is based largely on previously published material rather than on firsthand observations and investigations. The discussion of the rubber industry in Malaya did not benefit from the studies by P. T. Bauer; instead, the author repeats several one-sided and misleading arguments in favor of the plantation and against the peasant rubber grower.

In general, however, Dr. Jacoby has rendered a service in bringing together within a single volume a large mass of data that will enable the reader to understand more fully current events in Southeast Asia. An extensive bibliography will aid those who wish to study the region further.—KARL J. PELZER

LOS DIBUJOS GIGANTESCOS EN EL SUELO DE LAS PAMPAS DE NAZCA Y PALPA. By MARIA REICHE. 30 pp.; maps, ill. Editora Médica Peruana, S.A. (Azangaro 906), Lima, Peru, n. d. S/o 8.00. 6¾ x 9½ inches.

The region extending from a short distance north of Palpa, Department of Ica, Peru, to the valleys south of Nazca is especially rich in surface markings made by man in prehistoric times. This concentration is due to the nature of the soil and to surrounding elevations that afford protection against winds and drifting sand.

The soil, in addition to being absolutely dry, has a peculiar color stratification. The surface layer is very dark, owing to the oxidation of iron, and beneath it is a nearly white or yellowish layer. This is the vast "blackboard" on which man once made the marks that are today suspected of being astronomical records.

Stimulated by the work of Paul Kosak of Long Island University, Miss Reiche has been studying this group of markings in detail since 1941. Her work has been aided especially by the Escuela de Altos Estudios of the University of San Marcos, by the Servicio Geográfico of the Army, and by the Servicio Aerofotográfico. In the present publication she gives some

of her results and methods under the following headings: general description, location, form, visibility, size, the problem of reproduction, some detailed characteristics, the spirals, orientation of the markings, and markings in danger of destruction.

The photographs and maps show four types of markings: (1) virtually straight, long lines, radiating from centers or more or less parallel; (2) straight-sided trapezoidal or triangular figures, isolated or radiating from centers; (3) figures formed by curved lines, sometimes resembling labyrinths; and (4) anthropomorphic figures, the details of which are best seen from the air. Size varies enormously, but size repetitions suggest that a measuring standard might have been in existence. The largest marking Miss Reiche reports has an average breadth of 50 meters and extends for a distance of 1700 meters. Such dimensions, together with air views showing high pattern density, make it obvious that much human labor was expended here.

It has not been Miss Reiche's purpose in this publication to go into the details of astronomical observations. This she reserves for another time. However, she brings out such facts as the following: (1) many of the lines can be associated with notches in the mountainous horizon, an indication that they were constructed with a view to that direction; (2) lines trending in certain directions are commoner than others, and especially those with a margin of variation between N 68° 15' E and N 70° 10' E; (3) certain markings could have indicated the position of the rising or setting of certain stars in the constellation Ursa Major during the interval between 500 B.C. and A.D. 1500; (4) there are lines approximating the meridian, which favor the astronomical hypothesis.

Finally, Miss Reiche makes it clear that, with the Pan-American Highway passing through this region and obliterating parts of the markings, there is imminent danger that many will soon be lost entirely. This fact emphasizes the importance of her studies on these intriguing records of the past.—T. D. STEWART

HISTORY OF THE WHITE PINE INDUSTRY IN MINNESOTA. By AGNES M. LARSON. xv and 432 pp.; map, ills., index. University of Minnesota Press, Minneapolis, 1949. \$7.50. 9 $\frac{1}{4}$ x 6 inches.

In this study of the white-pine industry of Minnesota, Professor Larson, chairman of the Department of History at St. Olaf College, has made an excellent contribution to the regional history and historical geography of the Upper Great Lakes area and the upper Mississippi Valley.

Minnesota's pineries were the last of the great northern pine forests to be depleted. The advent of the white-pine industry in the St. Croix Valley in the 1840's and 1850's corresponded with its demise at the eastern end of the northern forest in Maine. Men from this state were important in the upper Mississippi region, both as sawmill owners and as lumberjacks. The first lumber camps were even called State-of-Maine camps. Tea was the drink of the lumberjacks. Not until other eastern Americans and Scandinavians began to enter the woods in the seventies and eighties did the lumber camps as we knew them at the start of this century develop; the importance of coffee in the lumber camp, the "Paul Bunyan" stories, the ice road for transport of logs, and many other regional characteristics postdate the "Maine era."

The author never loses sight of the importance of the market in the development and continuance of the lumber industry. Consequently, she ably presents the downriver rafting

of logs to St. Louis, the development of downriver sawmill centers such as Winona, La Crosse, Dubuque, Davenport, Clinton, and Fort Madison, all well removed from the pineries, and the coming of the railroads, which broadened the market for white pine and permitted the forest region to supply lumber for the settlement of the prairies of southwestern Minnesota, Iowa, Nebraska, and the Dakotas.

Little of the Great Lakes portion of the white-pine industry is to be found in the study, because Minnesota's markets lay southward and westward, and most of the logging streams were in the Mississippi watershed. Furthermore, at the height of logging in the state, Michigan and northeastern Wisconsin were still pinery regions and serviced the Great Lakes markets from Chicago to Buffalo. Only during the last stages of Minnesota logging, 1890 to 1910, did the heart of lumbering in the Great Lakes basin lie north and northeast of Duluth, then an important sawmill town.

Perhaps the most surprising fact to the reader not familiar with the regional history is the past importance of St. Anthony Falls-Minneapolis as a great sawmill center. Names of families more recently associated with flour milling at this location appeared during the sawmill period; several of the sawmill operators were successful in transferring their capital and managerial ability from lumber, as this resource dwindled along the farthest upper Mississippi and the Rum, to wheat and flour as the railroads were built and the prairies were developed. The 60 years or more of logging and lumbering are thus tied intimately to later regional growth and development.

The white-pine story ends shortly after the beginning of the present century, when the loggers at last reached the remotest part of the pineries in northwestern Minnesota east of the Red River Valley, and the man-made barrier of the Canadian frontier in the Rainy River district. The stage was set for the pressing regional problems of the present—conservation and rehabilitation of the cutovers.

To a geographer the greatest shortcoming of the book is the lack of maps. The location of the "Big Woods" (deciduous) of Minnesota is described by counties, as is the location of the pineries. Longitude $95^{\circ} 30'$, said to mark the western limit of white pine in the United States, is the western limit in northwestern Minnesota only. A map showing the original location of hardwoods, pineries, and prairie in the state would help the reader and point up the vastly different environments of northeastern and southwestern Minnesota. Offsetting this lack to a slight degree is a political map on which the counties of the state and a few of the towns are shown.—LOYAL DURAND, JR.

UNITED STATES INTERNATIONAL TIMBER TRADE IN THE PACIFIC AREA.

By IVAN M. ELCHIBEGOFF. xvii and 302 pp.; maps, diagrs., bibliogr., index. Stanford University Press, Stanford, Calif.; Oxford University Press, London, 1949. \$7.50. $10\frac{1}{4} \times 7$ inches.

Nearly half of the prewar timber exports of the United States originated in the Pacific Northwest and moved principally to markets in the Pacific area, especially Japan, China, Australia, and Latin America. These exports, which annually amounted to 15 to 20 per cent of Oregon and Washington production, were largely the result of regional over-expansion and consequent forced liquidation in the Douglas-fir industry. Prospects for the revival and greater stability of this trade, which has been completely upset by events of the past decade, are the concern of Dr. Elchibegoff. With an eye on both possible new markets

and export competition from other areas, he analyzes the timber resources, timber trade, and forest policy of 27 Pacific countries. Emphasis is on the United States, especially the West Coast, but the chapters on Manchuria and the Soviet Far Eastern Territory are of particular interest. In recognition of the competitive nature of forestry and farming with respect to land utilization, considerable attention is given to population growth and land-utilization trends. A disturbingly uncritical acceptance of statistics from whatever source has led the author to visualize vast land reserves waiting to be brought under cultivation in China and in the tropics. The result is sometimes pure fantasy, as when he concludes that "the time will probably never come when the pressure on land will necessitate clearing of Colombian forest land for agriculture" and that "there is no danger that a shortage of land [in Mexico] will necessitate clearing of forest land." He expresses a naive impatience at the "very slow" rate of population growth in these and other Latin-American countries in view of their "rich natural resources." Nowhere is there any suggestion of an awareness of the differential productive capacity of soils or agricultural systems, especially in the tropics.

Although this is essentially a source book on forest resources and timber trade, it contains chapters on conservation problems, tariff policy, ocean transportation, prices, production costs, and pulp, paper, and chemical developments. There is a vast fund of statistical data in the text and in numerous tables, and there are maps of the forest areas of most of the Pacific countries. The sources are chiefly prewar, but later developments are briefly noted, including the 1946 Forest Service reappraisal and the early reports of the United Nations Food and Agriculture Organization. The author concludes that the recent advances in scientific forestry and wood-waste utilization assure an early balance to our timber economy which may even provide a reasonably stable surplus for exports to overseas markets in the near future.—JAMES J. PARSONS

HONG KONG IN ITS GEOGRAPHICAL SETTING. By S. G. DAVIS. 226 pp.; maps, diagrs., ills., bibliogr., index. Collins, London, 1949. \$20.00 (Hong Kong). 8³/₄ × 5¹/₂ inches.

This is a definitive work on Hong Kong by a competent author. Dr. Davis, geographer and geologist, is lecturer in the University of Hong Kong. He has had access to government archives and has used unofficial material as well. And he has had direct contact with the land—he did field work on mineral deposits as a geologist for the Hong Kong government and dug into the rocks as a prisoner of war of the Japanese.

He gives a picture of the 400-square-mile colony, crowded on rocky land, always desperate for water, populated by transients—98 per cent Chinese in 1941. Most of the general information covers the 100-year period between the establishment of the colony in 1841 and the disruption caused by the war, but current trade data are included (there are six statistical appendixes). The source of Hong Kong's wealth is trade, and the emphasis of the book is on trade, the port, communications, and the economic potential.

The sections on geology and minerals reflect the author's competence, though the casual reader will find them technical and overlong. Many pages are devoted to agriculture and fishing, neither of which is of great importance to the colony. Nowhere is there a discussion of Hong Kong as one of the three bastions of Western power in Asia, though there is a hint in the introduction—during the Japanese advance the population was made aware that Singapore was 1500 miles away, and Manila 650 miles.

There are two minor flaws. The bibliography contains many trivial and tangential references—probably a result of the attempt to list all possible sources. In his last chapter, on the destiny of Hong Kong, Davis fails to mention the threat of the Chinese Communists. He contents himself with the academic question whether Hong Kong should belong to China, to which it is physiographically linked, or whether it should be retained by Britain, whose people developed it.—GEORGE BEISHLAG

BURMESE ECONOMIC LIFE. By J. RUSSELL ANDRUS. xxii and 362 pp.; maps, diagr., index. Stanford University Press, Stanford, Calif., 1947. \$4.00. 8¾ x 5½ inches.

This study of Burmese economy was undertaken during the war and later expanded to cover the changes that occurred during the Japanese occupation and after liberation, up to the middle of 1947. It is a detailed and well-documented account of the economic life of Burma just before independence. This fact alone assures the book a special place in the literature on Burma, since it furnishes material for comparison between economic conditions before and after January, 1948, the date of the establishment of the independent Union of Burma.

Three brief chapters familiarize the reader with the major geographical divisions, the economic history, and the ethnic composition of the people. The statement that "Burma, with the exception of some hill areas, is fortunate in having a fairly homogeneous population, without the communal problems which afflict some neighboring countries" comes as a surprise in view of the serious friction between the Karens and the Burmans that led to the recent revolt. As Furnivall has pointed out, both the British government and American Baptist missionaries have contributed to the growth of deep-seated racial animosity between Karens and Burmans. The Karens have played a role similar to that played by the Amboinese in Indonesia.

The main part of the book examines all phases of Burma's economy. Of special interest to the geographer are the chapters on agriculture, land tenure, forestry, and mining. Lower Burma, which plays so important a role in the country's export trade, has been developed since the establishment of British rule. The pioneering Burman from central Burma was often financed by Indian moneylenders, the Chettyars. During the depression it suddenly became apparent to how great an extent the ricelands of Lower Burma had been pledged as security. In the author's opinion, the Indians were primarily interested in receiving their regular interest payments and regretfully took possession of the land when the Burmans were unable to meet their obligations. The political agitation that followed led to such legislation as the Land Alienation Act, the Tenancy Act, and the Land Purchase Act. Although these acts were passed before World War II, the war in most instances prevented implementation, and it now remains for the new Burma government to carry them out.

Mr. Andrus believes that Burma was as hard hit by the war as any other Asiatic country, with the possible exception of Japan. But the war also provided the Burmans with stimuli and possibilities that proved valuable in the postwar period and are still felt now that the country has gained its independence.

The fact that Burma is much better off than some of its neighbors in that the ratio between natural resources and population is favorable speaks well for the future, provided that the government can re-establish law and order and rehabilitate the transport system and the basic industries. However, the present export policy, which enables the government to profit more from handling the rice export than the producer who grows, harvests, and markets the

rice, may delay the date at which Burma will once more be in the position to export more than three million tons of rice.—KARL J. PELZER

ESSAI D'UNE FORMULE DE CLASSIFICATION DES CLIMATS DU LEVANT. By CH. COMBIER. Maps, diags., bibliogr. *Publs. Techniques et Scientifiques de l'École Française d'Ingénieurs de Beyrouth* No. 14, 1948, pp. 7-27.

L'ARIDITÉ ET L'ÉCOULEMENT DANS LES PAYS DU MOYEN-ORIENT. By IBRAHIM ABD-EL-AL. Maps, diags., bibliogr. *Ibid.*, pp. 29-49.

LE LITANI: Étude hydrologique. By I. ABD-EL-AL. ix and 166 pp.; maps, diags., ills., bibliogr. République Libanaise, Service Hydraulique, Beirut, 1948. 11 x 8 inches.

In the first of the two papers listed above, Père Combiér, head of the Lebanon's chief meteorological station, discusses favorably the application of a formula by L. Emberger, modified, to the classification of the climates of the Levant. The empirical expression concerned gives the "hygrothermic quotient" of a place. Climograms based on this formula furnish a better representation of climatic characteristics than the usual ones in which temperature and rainfall figures are plotted. Informative maps show lines of equal aridity in January, April, July, and October.

Mr Abd-el-Al uses another empirical formula, De Martonne's "index of aridity," to divide Syria and the Lebanon into zones of equal aridity. These climatic zones are also hydrographic zones, practically coincident with the areic, endoreic, and exoreic drainage areas. Stream flow starts with a rainfall of about a hundred millimeters, a low figure, presumably because of the concentration of the winter rainfall in heavy downpours. Since the coastal mountains are largely made up of calcareous rocks, they absorb a high proportion of the precipitation, which they feed out to streams from perennial springs, ensuring a steady flow throughout the summer drought.

One welcomes the initiative of the Lebanese government in subsidizing the publication of "Le Litani"; it shows that the government of this four-year-old republic is aware of the importance of such scientific studies as a basis for technical advance. The book also is welcome as one of the first considerable works of its kind to come from an Arab pen; and for the excellent maps and creditable production of a difficult piece of work the Catholic Press in Beirut is to be congratulated. The author should, certainly, have been more careful; the reader is assisted neither by a table of contents nor by an index, and there are a number of typographical errors.

Mr. Abd-el-Al aims to study the hydrology of the Lebanon's principal river, the Litani, the way in which its valley and its waters are used at present, and plans for its development. The book could have been more selective and better balanced. The one large project recently put into operation to utilize Litani water, the Tyre-Sidon irrigation scheme, is dismissed in a paragraph, though a mass of diagrams relating to it are inserted at the end of the book. At the other extreme, a good deal is made of a plan to prevent floods by cutting through 11 meanders. This can hardly be called a major undertaking, but though the work was started in 1942, it is still unfinished.

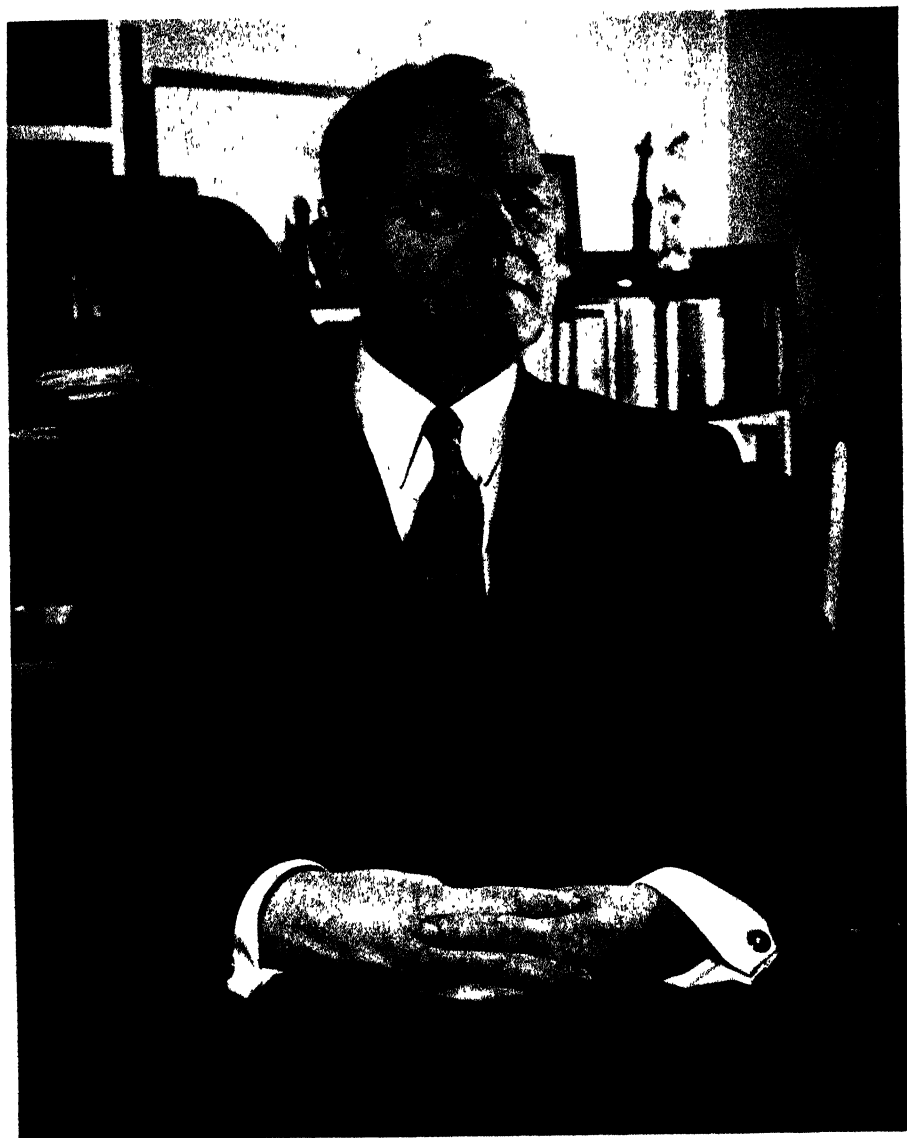
Nevertheless, the study is full of interest. The Litani's upper course is through the great tectonic trough (the Beqa') between the Lebanon and Anti-Lebanon Mountains; the river then makes a right-angled turn from its natural line of flow to the Jordan Valley and finds its

way to the Mediterranean via a gorge cut through the Lebanon range. The regime of the river is strongly influenced by the highly accentuated relief and the consequent marked climatic changes: a latitudinal line 30 miles long from Beirut eastward passes from a coastal Mediterranean climate, across the 8500-foot ridge of the Lebanon Mountains and the deep Beqa' with its Mediterranean-continental climate (well described in a chapter by Père Combiér), to the Anti-Lebanon, which rise to nearly 8000 feet. The calcareous rocks of the basin provide another complication, dealt with by Mr. Abd-el-Al both in this book and in the paper reviewed above and summarized in another paper (*L'originalité de l'écoulement dans les massifs calcaires Libano-Syriens, Beirut, 1949*), in which he describes their role thus: "La constitution géologique vient corriger les excès du climat par la mise en réserve dans les massifs calcaires des eaux abondantes de l'hiver et leur restitution par les sources puissantes . . . Ce pays, subissant un climat excessif, serait plus desséché si son sol avait été plus imperméable" (separate page, headed "Analyse"). More might have been made of the influence of the long spring-summer snow melt in the mountains on the regime of the river.

Students of karst conditions elsewhere will find much to interest them in this book, and they will not be alone in hoping that the author will publish in one of the international languages the results of his studies of other Lebanese rivers where further "remarkably original" features are found.—NORMAN N. LEWIS

SHADOWS IN THE SUN. By STEPHEN TAYLOR and PHYLLIS GADSDEN. 187 pp.; maps, diags., ills., index. George G. Harrap & Co. Ltd., London, Sydney, etc., 1949. 15s. 9 x 5½ inches.

"Shadows in the Sun" was written to inform the British people about health conditions and medical and social problems in their colonial empire. Leprosy, malaria, yaws, scrub typhus, yellow fever, ancylostomiasis, and sleeping sickness are reviewed against the historical and geographical background of the particular British colonies in which they flourish. In each case the most important problems are clearly explained in a way that cannot fail to catch the reader's interest. At the same time, the geographical correlations are discussed, and their significance emphasized. Why did leprosy disappear from Europe before modern sanitary measures were introduced? What is the relationship between malaria and rainfall, between yaws and social depression, between scrub typhus and the conditions of the soil? Why is yellow fever a less severe disease in East Africa than in West Africa? How do social habits, temperature, rainfall, and soil conditions combine to support hookworm infection? What has been done in Cyprus to organize rural sanitation? All this and more makes attractive reading for the professional and valuable teaching for the layman.



ISAIAH BOWMAN

ISAIAH BOWMAN

V A L E

*The splendid plans
You made triumphant
Are lighted by your own true words
That linger still,
And by the recollection of your faith
In life's supreme achievements.
In half obliterated paths of swift recall,
We still behold you
In moments, hours and days
We shared with you,
With pride and admiration.
The deeper meanings of your life have come
To float upon our tide of treasured thought,
Along whose whispering sands
Still may we find
Strange sparkling shells that lie
Bright for the deeds you wrought,
Memories of you,
That will not die.*

ARCHER M. HUNTINGTON

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RESOLUTION

At the meeting of the Council of the American Geographical Society on February 15, 1950, the following resolution was unanimously adopted:

RESOLVED, That the Council of the American Geographical Society record its deep sense of loss in the death of Isaiah Bowman at Baltimore, Maryland, on January 6, 1950. Through the sheer force of his character and personality Isaiah Bowman rendered distinguished service to his profession, the institutions he served, and his country. He was educated at the State Normal College, Ypsilanti, Michigan, where he received lasting inspiration from Mark Jefferson, and at Harvard, where his association with William Morris Davis was equally stimulating. For upwards of ten years he taught at Yale and there received his doctoral degree. During this period he participated in or led no fewer than three field expeditions to South America. He envisaged the role of a geographer not merely as that of the cloistered student in an institute of higher learning but as the pursuer of an active and dynamic career in which political, scientific, and social interests should be welded into an effective unit.

In 1915 he was appointed Director of the American Geographical Society and immediately demonstrated his great capacity for organization and leadership. He transformed the Society from the custodian of geographical collections into a forward-looking research institution, and he did this so effectively that when Colonel E. M. House was appointed by President Woodrow Wilson to organize a group of experts to prepare for the anticipated peace negotiations at the end of World War I, Isaiah Bowman was one of the first persons named as a member of this group, which was called "The Inquiry." Shortly thereafter, and owing largely to Mr. Bowman's great capacity for organization and his readiness to undertake almost any task, The Inquiry made its headquarters at the Society's building, and many of the preliminary conferences among the delegates to the American Commission to Negotiate Peace were held in Mr. Bowman's office. He himself was selected to go to Paris as Chief Territorial Specialist, and there

he played an important role in advising President Wilson and the other American delegates in the negotiation of the Treaty of Versailles.

Upon his return in 1920, Mr. Bowman developed the program he had originally initiated of making the American Geographical Society the principal geographical research organization in the United States. First among the undertakings then put in motion was the Millionth Map of Latin America. This great cartographic project, which necessarily involved the co-operation of all the Latin-American nations, gave Mr. Bowman an opportunity to display his rare talent of persuading people with conflicting interests to work together for a common end. The conception and the ultimate publication of the Millionth Map were due primarily to his vision, scholarship, and personality. No less far-reaching were the programs of pioneer settlement that he began and inspired.

In 1935, after twenty years of invaluable services to the Society, Mr. Bowman left with great regret to become President of The Johns Hopkins University. Again his organizing and administrative skill was called into play, and in a remarkably short time he reorganized the financial affairs of the university.

With the outbreak of the Second World War, Mr. Bowman was called upon to play an important role in international affairs. President Roosevelt sought his advice, and he was appointed a consultant to the Department of State. The precise nature of his services has never been fully disclosed, but he played a prominent part in the organization of the United Nations at Dumbarton Oaks and at San Francisco and continued until the last as an active adviser to the Department of State on international questions.

No description of his achievements can convey the force of his personality. Physically and mentally, he was alert, incisive, and tireless. In spite of his extraordinary memory and his ability to analyze quickly any problem presented to him, he was never intolerant and was therefore able to deal with people in all walks of life in the friendliest spirit. His warm human understanding and delightful sense of humor made him a charming companion to young and old alike, and he enjoyed talking with children as much as with the leaders of states. To those of us who had the privilege of knowing and working with Isaiah Bowman his untimely death comes as a grievous shock, and we mourn the loss of a great leader and sincere friend whose influence will endure undimmed by the passage of time.

Tall Oaks From Little Acorns

Reflection on the contents of this issue of the *Geographical Review* inspires—appropriately enough in early spring—comment on the burgeoning that follows the implantation of an idea. One case in point is the Society's Glacier Study Program, which has grown in the past few years from a modest beginning to a comprehensive undertaking that has far-reaching scientific implications and that now embraces the cooperative enterprise of numerous individuals and agencies. Messrs. Field and Miller of the Society's staff tell the story of this development, with particular reference to the Juneau Ice Field Research Project, and survey the accomplishments to date, both in glaciology and in tangent disciplines—plant ecology, geophysics, meteorology, and so on.

Glacier Study Program

Within the framework they provide, Professor Donald B. Lawrence gives a more detailed account of the ecological studies carried out in the summer field season of 1949. He presents a challenging hypothesis concerning the possible relation between periods of glacier advance, as determined from tree-ring analysis, and periods of sunspot dearth, as recorded since Galileo's time, with the provocative conclusion that "if further work confirms the relation suggested here between reduced solar activity and glacier advance, we may have new evidence for testing old theories regarding the causes of Pleistocene glaciation."

Another sturdy sapling that has now become a wide-branching and sizable tree is Professor C. W. Thornthwaite's classification of climates. Since its first appearance in the *Geographical Review* in 1931, and particularly since the publication of a modified and refined version in 1948, Dr. Thornthwaite's work has produced uncounted offshoots. One of the more recent and illuminating applications of the revised system is currently presented: Professor Sirri Erinç defines the climatic regions of Turkey, with special reference to areas of moisture deficiency. The importance of such a study in a country where 85 per cent of the population are engaged in agriculture and where a large proportion of the total area is subject to drought needs no emphasis.

Two Tall Oaks

The lively "profile" of five Indian cities, by Professors Spate and Ahmad, has already borne interesting fruit. While their article was still in the editorial works, announcement was made in the newspapers of the plans for a new city—as yet unnamed—to be the capital of the province of East Punjab. An inquiry addressed to Mr. Albert Mayer, the American architect and planning consultant commissioned to design the new city, elicited not only a welcome note on the projected capital for our *Geographical Record* section but also

the useful information that master plans have recently been initiated for three of our "five cities"—Cawnpore, Benares, and Agra. This fact would seem to add one more ring to the cross section of cultural history described by Professors Spate and Ahmad.

The growth of geographical activity in two countries, one in the East, the other in the West, where geography as a discipline has been implanted for only a relatively short time, is measured by the yardstick of recent publications. Dr. Spate appraises the productivity of Indian geographers and finds that "Indian geography is still young, but there is already ample promise and fair achievement."

Dr. Clark performs a like service for Canadian geography. His comprehensive survey of some two hundred works and his interpretation of the trends they reflect grew out of a proposed review of several new Canadian books—surely a first-class example of that burgeoning we mentioned.

Fertile fields for further scientific investigation are indicated in several articles. From his experience as leader of a Japanese expedition to the little-known Great Khingan region of northern Manchuria, Dr. Kinji Imanishi gives us an ecologist's picture of this remote country and its inhabitants, with glimpses of such arresting problems as agriculture in the pioneer fringe and Chinese-Russian culture contrasts.

Professor M. W. de Laubenfels, engaged in marine zoological studies in the Marshall Islands, found little published information on the current pattern of the surrounding seas. His method of remedying the lack—the interrogation of the native mariners—produced results both interesting and useful. Perhaps before too long we may look forward to confirmation by means of modern instruments and techniques.

Our last "acorn" gives promise of steady and healthy growth. The First African International Scientific Conference, held in Johannesburg in October, 1949, initiated plans for integrated scientific research. Through the medium of a proposed African Scientific Council, these plans if realized will have importance for all scientists, and particularly, perhaps, for geographers. In his report on the Conference, Professor Monod makes this clear: "It was natural—and indeed almost inevitable—that the Johannesburg Conference . . . should think of its problems largely in terms of geography; that is to say, in terms of intelligent synthesis, seeking to bring each part into harmony with the greatest possible number of causal factors—physical, biological, and human. To insist on the interdependence of things and beings is always and everywhere to serve the cause of geography rightly understood."

THE JUNEAU ICE FIELD RESEARCH PROJECT

W. O. FIELD, JR. AND MAYNARD M. MILLER

DURING the past quarter of a century most observations on the extent of land and sea ice have indicated a definite amelioration of climate. We may be witnessing the last stages of what the late François E. Matthes has called "The Little Ice Age," which began about the end of the sixteenth century. Professor H. W. Ahlmann, the well-known Scandinavian glaciologist, has stated: "It is proved by climatological, oceanographical, glaciological, and biological facts that a climatic fluctuation is now going on. In high northern latitudes it expresses itself in an improvement of the temperature, which in the last decades has been the greatest during the last 200 years. In some parts of the Tropics, e.g. East Africa, there is desiccation, probably belonging to the same climatic fluctuation. This climatic change is the first one in the endless series of climatic variations and fluctuations in the past and coming history of the Earth, which we can study, measure and possibly also explain."¹ Referring more specifically to the role of glaciology, he continues: "Glaciers are very sensitive to climatic changes . . . They are natural climatic recorders even where no meteorological stations exist. They also tell us the history of the climate from times before any scientific investigations of climates had begun."

In the summer of 1941 the American Geographical Society, motivated in part by the almost world-wide reports of enormous shrinkage of glaciers, sent a small field party into Southeastern Alaska, par excellence a region for glacier study.² One of the areas visited was Taku Inlet, where an unusually interesting situation exists. Four large glaciers flow southward into the Taku River Valley and terminate at or near sea level; Norris Glacier and the Twin Glaciers have been receding, but, strangely, Taku Glacier and its distributary, Hole-in-the-Wall Glacier, have been advancing. Yet all four

¹ Personal communication, 1947. Professor Ahlmann's studies of the regimen of glaciers in the North Atlantic region during the last 20 years have pioneered the way to new concepts and techniques. See, for example, "Glaciological Research on the North Atlantic Coasts," *Royal Geogr. Soc. Research Ser. No. 1*, London, 1948. These studies have guided us in formulating the Society's present program. See also Gordon Manley: Glaciological Research on the North Atlantic Coasts, A Review, *Geogr. Rev.*, Vol. 39, 1949, pp. 136-138.

² See W. O. Field, Jr.: Glacier Studies in Alaska, 1941, *Geogr. Rev.*, Vol. 32, 1942, pp. 154-155.

➤ MR. FIELD is head of the Society's Department of Exploration and Field Research, which is presently engaged on a comprehensive glacier study program, and is chairman of the Committee on Glaciers, Section of Hydrology, American Geophysical Union. MR. MILLER is research associate on the Society's staff and field director of the Juneau Ice Field Research Project.

glaciers originate in the Juneau Ice Field, which, with its outflowing glaciers, covers approximately 700 square miles. (See Figs. 1 and 2, pp. 192 and 195). This continuous névé has no marked differences in elevation; presumably, therefore, the glaciers are subject to the same climatic influences. The advance of Taku (roughly $3\frac{1}{2}$ miles in 50 years) is not the sole case of advance in Alaska, but it is certainly one of the most impressive as regards terminal extension and thickening, which is apparent for at least seven miles above the present terminus. Yet in the Glacier Bay area, some 100 miles to the west, the greatest deglaciation known in the world within the last two centuries has occurred.³ If this recession is the result of even a slight climatic amelioration, how can the advance of Taku Glacier be explained? It is possible that Glacier Bay is affected by factors not present in the Taku Inlet area, but how then can we explain the difference in behavior of four glaciers situated within a few miles of each other and subject to the same variations in temperature and snowfall? It would appear that other factors of which we as yet know very little are responsible. It may well be that an important cause is englacial, or even physiographic, and if so that it must be adequately understood before the true relationship between the behavior of these particular glaciers and climatic change can be worked out.

It became fairly clear to us in 1941 that a full explanation was more likely to be found in the area of accumulation of the glaciers than at their termini. Numerous other glaciological problems, some of great significance from both the practical and the theoretical points of view, also needed clarification. As a result the Society in 1948 formulated plans for a program which would initiate over a period of years comprehensive studies not only on the Juneau Ice Field but on other representative ice masses in both North and South America as part of the world-wide glaciological research in which scientists of many countries are engaged.⁴ This program was experimental and, aside from the purely glaciological aspects, presented challenging possibilities in other branches of science and in the training of personnel.

THE GLACIER STUDY PROGRAM

It seemed reasonable to assume that an attempt to find the answer to the phenomenon of the Taku Inlet area might well reveal information on

³ W. S. Cooper: The Problem of Glacier Bay, Alaska, *Geogr. Rev.*, Vol. 27, 1937, pp. 37-62; W. O. Field, Jr.: Glacier Recession in Muir Inlet, Glacier Bay, Alaska, *ibid.*, Vol. 37, 1947, pp. 369-399.

⁴ In the winter of 1949 the American Geographical Society sent a party of two to South America for correlative studies in the Andes of Argentine Patagonia. A report on this work will appear in a forthcoming number of the *Geographical Review*.



FIG. 1.—Western part of the Juneau Ice Field, showing névé and nunataks. Lynn Canal in right background. View south-southwest. (Trimetrogon aerial photograph, U. S. Air Forces, 1942.)



FIG. 2—View northwest across the upper Taku Glacier, showing firn line between névé zone and exposed blue ice.

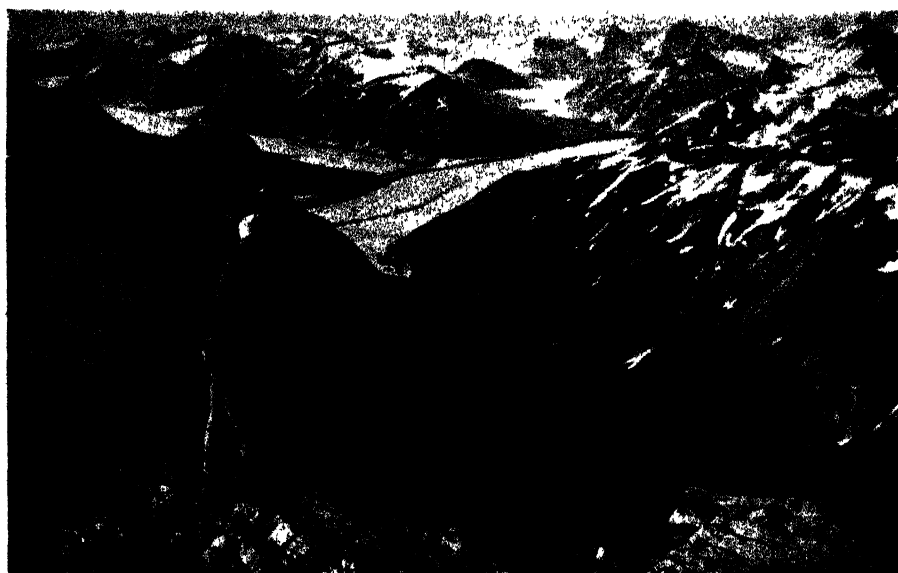


FIG. 3—Recently deglaciated U-shaped valley containing an impounded lake filled with icebergs on the northern edge of the ice field. In background, unnamed glacier which drains to the west in the direction of Lynn Canal.



FIG. 4—A light plane based at Juneau drops supplies and mail at an outlying camp on the Juneau Ice Field



FIG. 5—Research station housing meteorological and glaciological equipment at Camp 10. The hut is situated at an elevation of 4100 feet on a recently deglaciated spur of a nunatak near the center of the ice field.

the causes of glacier variations in general, the waxing and waning of the great ice sheets, and the delicate balance of forces that governs the existence of the Greenland Icecap and the continental ice sheet of Antarctica. At the same time there might emerge a better basis of correlation between glacier variation and observed changes in meteorological conditions. Previous detailed studies in the Alps, in Scandinavia, and in Iceland have for the most part dealt with shrinking glaciers; those of Greenland and the Antarctic with ice masses so huge that no true picture of their economy and hydrologic balance can be obtained.

The Juneau Ice Field area seemed to offer a number of advantages for analysis and integrated studies in addition to the simultaneous advance and retreat of adjacent glaciers. At least eleven large valley glaciers flow from the ice field; the termini of six of these have been studied for some decades, and aerial photographs of the rest are available. The area is close to Juneau, which can be readily reached by air or sea, and the glaciers on three sides of the ice field are accessible with relative ease. The meteorological record in the vicinity has been obtained from several stations; one of these, that of the United States Weather Bureau in Juneau, dates from the 1890's. Mapping of the general features of the region was undertaken as early as 1893 by the Canadian Boundary Survey and has been supplemented in recent years by photographic coverage. Finally, relief on the glaciers and the *névé* is not excessive, and from the outset it appeared that most areas on the upper ice could be reached without undue effort or hazard.

Basically, the purpose of the program was to study the system of the glaciers as a whole, the external factors influencing them, and their past behavior. This included a study of meteorological conditions and solar radiation at high and low levels, the accumulation of snow in the *névé*, the mechanics by which the snow is transformed into ice and flows to lower elevations, the rate of melting and evaporation, and the evidences of former variations in lateral extent and volume. Supplementary studies and activities were also to be undertaken. A survey of the locality was necessary; the bedrock geology was of interest; the characteristics of the vegetation had a bearing on problems of plant ecology and former expansions of the ice. In addition, the logistic aspect was complicated, and it was necessary to test equipment and develop or improve certain techniques of operation.

In the summer of 1948 a reconnaissance party was organized to determine routes of approach and to find out what equipment and supplies would be needed to carry out the full program. The work of this party of six men

has already been reported.⁵ During three weeks on the ice, and aided by an airdrop of supplies by a Navy plane and other logistic support provided through the Research and Development Board of the National Military Establishment, the party accomplished its reconnaissance mission and began a series of glaciological, geological, botanical, and meteorological observations to pave the way for a more extended effort in the following year.

Also in the summer of 1948, the Arctic Institute of North America began a series of studies in the St. Elias Range, 250 miles to the northwest. Throughout both the 1948 and the 1949 seasons close cooperation was maintained between the two expeditions.

SUMMER WORK OF 1949

A contract with the Office of Naval Research provided most of the funds for the 1949 field work of the Juneau Ice Field Research Project. Through the Research and Development Board, supplies and equipment were obtained from the Quartermaster Corps, the Signal Corps, and the Air Matériel Command. Air support was provided by Navy planes from Kodiak, the Military Air Transport Service, and the Air Force Tenth Rescue Squadron, based at Anchorage. The Arctic Institute provided financial support as well as the use of a ski-wheel plane for a flight to the ice field. In Juneau the Forest Service was most helpful, providing warehouse space and transport facilities and designating a representative to serve as observer with the ice-field party.

Personnel and Establishment of the Main Base

In 1949 the major part of the field party carried on studies in meteorology and high-level glaciology and was responsible for the logistics. A geophysical team from Stanford Research Institute undertook measurements of ice thickness on Taku Glacier both at high and low levels. Another unit, the plant-ecology team, worked entirely in the terminal areas of the glaciers; however, in order to complete the vegetation studies, one botanist was assigned to the high-level party for work on the nunataks and ridges rising above the névé.

Personnel⁶ were chosen for their ability to undertake or assist in the type

⁵ M. M. Miller: Progress Report of the Juneau Ice Field Research Project, 1948, American Geographical Society, New York, 1949. (Mimeographed.)

⁶ The personnel of the field party, with their institutional and professional affiliations and the principal specialty to which they devoted their major effort in the field, were as follows:

Glaciology and geology: Maynard M. Miller, American Geographical Society, leader of the ice-field

of work planned and their experience on glaciers and mountain terrain. The undertaking was essentially one for young men and provided an opportunity for a number of undergraduate and graduate students to gain experience, under the guidance of competent scientists, in glaciological and related studies that they might continue in the years to come.

The most complicated part of the work was the transportation of equipment and supplies to the points selected for camps on the ice field. The accessibility and relative ease of approach make it fairly simple to walk up to the ice field, but to back-pack supplies other than personal gear is tedious and difficult, and air supply is necessary. By July 15 some 13 tons of supplies and equipment had been landed by airdrop at designated points on the ice field—58 drops by parachute and 300 by free fall. Meanwhile advance parties had climbed to the ice field through the Taku Valley and established themselves at the camps set up in 1948. Working forward from these nuclei, the men recovered the air-dropped material and established additional camps. By July 4 the main base camp was in operation.

The site for the main base had been selected during aerial reconnaissance, and materials were later dropped with which to construct a small research station designed to serve as a headquarters for the summer work and as a storage place for equipment and supplies for other years; such a station would in fact be essential for the winter observations planned for the future. Construction took 10 days and went on regardless of weather. The hut, 14 by 20 feet, was built of wood sheathed with corrugated aluminum and was well insulated. It stands roughly in the center of the ice field, on the west

party; Robert B. Forbes, University of Washington; G. Robert Lange, University of New Hampshire; F. Beach Leighton, California Institute of Technology; Melvin G. Marcus, Yale University.

Plant Ecology: Leader, Dr. Donald B. Lawrence, Associate Professor, Department of Botany, University of Minnesota; Assistants: Lloyd C. Hulbert, University of Montana; Mrs. E. B. Lawrence; Richard T. Ward, University of Minnesota.

Geophysics: (Stanford Research Institute), Leader, Dr. Thomas C. Poulter, Associate Director of the Institute; C. F. Allen; Stephen Miller.

Meteorology: Norman E. Turner, Mount Washington Observatory, New Hampshire, senior meteorologist; Charles O. Harrington, Blue Hill Observatory, Harvard University; Francis Pooler, Massachusetts Institute of Technology.

Surveying: Richard G. Merritt, Yale University, in charge; Arthur Holben, University of Washington.

Other members of ice-field party: Warren Clarke, communications and field assistant; J. Malcolm Greany, photographer; Dr. Theodore R. Haley, Flower Hospital, New York City, chief medical officer; Duncan McCollister, Tufts Medical School, medical officer and plant ecologist; Zach Stewart, Yale University, photographer and field assistant; Anthony Thomas, United States Forest Service, observer; Dean Williams, communications and logistics assistant.

The authors extend sincere appreciation to these individuals, to the air crews who participated in the air lift, and to the many others who aided the project. They also wish to record their gratitude to the government agencies and other organizations who cooperated.

side of a nunatak at an elevation of 4100 feet, and overlooks the broad expanse of the upper Taku Glacier.

The Ice-Field Party

Three meteorologists were attached to the ice-field party. Instruments provided by the Signal Corps were set up at the research station and were manned continuously throughout the summer. An intermediate station was established at Camp 12 on the ridge above the lower Taku Glacier at an elevation of 2500 feet, and records were also kept at Taku Lodge, in the valley some 20 feet above sea level. These three stations provided a basis for comparison with the records made at the weather stations in Juneau and Annex Creek (in lower Taku Inlet) and at stations in Canada at Atlin and the Polaris-Taku Mine. In addition to the standard meteorological observations, a sunshine recorder was used. Solar radiation equipment was not available in 1949, but it is hoped that this may be included in 1950.

Glaciological work included studies of the firn to determine its water content, the manner and rate of meltwater circulation, density, and structure; determination of the annual accumulation of snow during as many previous years as could be detected; studies of surface movement of the ice in different areas and of ablation of the surface at different points on the névé; and observations of the névé or firn line at the height of the melting season late in August. The winter of 1948-1949 had produced far more than the normal snowfall in this area. This, combined with a cooler than average summer in 1949, caused the névé line to be three miles down glacier on the Taku from its position in 1948. Only further observations will disclose the mean position of the névé line, but we do know that the 1947-1948 budget year⁷ was less favorable to the glacier's regimen than that of 1948-1949.

Other members of the field party were engaged in mapping the region and in carrying on geological and botanical observations. Associated with these was the attempt to determine the line on the nunataks that would record the level of the ice field during its period of expansion about two centuries ago and, at a much higher level, the height of the ice during the Pleistocene. Long treks were made to the eastern, northern, and western rims of the ice field for physiographic observations. To the northeast, in the Talsekwe Glacier drainage area, and to the north, where the glaciers drain westward into Berners Bay and Lynn Canal, there are interesting structural features in

⁷ By "budget year" is meant the period from the first snowfall of winter through the ablation season of the following summer. In this area, judging from 1948 and 1949, the budget year begins the latter part of September.



FIG. 6—Measurements are made of the liquid-water content of firn snow, using a non-calorimetric method.

FIG. 7—Construction of the research station. The névé in the far background lies on the western branch of the upper Taku Glacier.

FIG. 8—Triangulation station at 5260 feet. In the background, 10 miles away, is Devils Paw (8584 feet) on the eastern edge of the Twin Glacier névé.

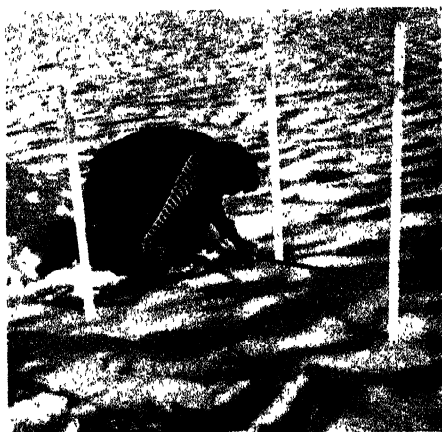


FIG. 9—Reading ablation stakes. These stakes were reset each morning and evening and painted white to reduce loosening by excessive absorption of sun's heat.

FIG. 10—An Air Force Tenth Rescue Squadron ski-wheeled C-47 after landing on the upper Taku névé.

FIG. 11—Interior of the meteorological station at Camp 10; the meteorologists relayed daily weather data by radio to Juneau.

the ice and physiographic phenomena associated with recent rapid ice shrinkage. Glaciers do not flow from the ice fields into these lateral valleys to such an extent as formerly. Marginal lakes occupy depressions from which the ice has recently disappeared and present aspects of particular interest, for example, the annual outbreak of the impounded waters, caused by the loosening or melting of the ice dams during the summer, and the reversal or divergence of ice from former directions of flow.

Special Investigations

The geophysical team, under the direction of Dr. Thomas C. Poulter, began its studies of ice thickness on the lower Taku Glacier, selected because of a unique situation that obtains there. As was mentioned above, Taku Glacier has been advancing since about 1900. In 1890 the United States Coast and Geodetic Survey mapped the inlet and made soundings nearly to its tide-water terminus; thus by computing the elevation above sea level of the present ice surface the total thickness of the glacier can be determined. (This would not be so if the ice were afloat, but since the deepest sounding in the fiord was 336 feet, the ice rests on the bottom.) Such a combination of factors, probably not found anywhere else in the world, provides unusually favorable circumstances in which to test the equipment and methods for measuring the thickness of ice. The method used, in which light charges are set off above the surface and the travel time of the resulting seismic waves measured, was devised by Dr. Poulter while engaged in studies of the Ross Shelf Ice with the Second Byrd Antarctic Expedition in 1933-1935 and has since been used extensively in exploration for petroleum. Nearly a month was spent on the lower glacier taking measurements and perfecting the procedures. Dr. Poulter's assistants and their equipment were then flown up to the ice field by the Air Force Tenth Rescue Squadron, in a ski-wheel C-47, under the command of Colonel Bernt Balchen. During the next few weeks, three profiles were made across the upper Taku, the first 11 miles above the terminus at about 2700 feet, the other two a few miles above the first across the lower ends of the two main branches of the glacier. These soundings are believed to be the most reliable so far made on ice in North America. They show maximum depths to 1534 feet.⁸

The work of the ecological unit is reported by Dr. Donald B. Lawrence elsewhere in this number of the *Geographical Review*. The studies reveal much of interest not only to glaciologists and plant ecologists but also to historians,

⁸ A detailed report of the geophysical work will appear in a forthcoming issue of the *Geographical Review*.

since the Taku Valley has long served as a natural channel for human activities between the coast and the interior.

SUMMARY OF THE 1949 FIELD WORK

The principal accomplishments of the 1949 field work may be summarized as follows:

1. A great deal of additional information was obtained, mainly through the vegetation studies, on the variations during the past six centuries of the glaciers emanating from the Juneau Ice Field.
2. Meteorological records were begun at five high-level stations that provide a basis for determining conditions on the ice field and for comparison with the records at the established weather stations at lower elevations on opposite sides of the ice field.
3. Valuable accumulation and ablation data were obtained, together with measurements of ice movement, from which to begin a detailed analysis of glacier regimen.
4. The depth of the ice was determined at four localities on the Taku Glacier, using a reflection seismic method. This measurement is essential in order to estimate the volume of ice being transferred from the area of accumulation to the area of ablation. It may also help to reveal how the movement of the ice at depth may compare in its rate of speed with observed surface movement.
5. Studies of the physical properties of ice, the structure and mechanics of glaciers, and the metamorphism of snow to ice were begun.
6. The geology and botany of the nunataks were studied for the first time in relation both to glaciology and geomorphology and to the broader aspects of regional interpretation.
7. Data were gathered from which to compile a detailed map of the ice field area. The map when complete will delineate the nunataks and the ice flow in the central part of the ice field with far more accuracy than they are shown on existing maps.
8. Equipment and supplies of all kinds and new logistic methods were tested, and effective operating techniques were extended and improved.
9. Perhaps of greatest significance in the long-term view was the establishment of a field laboratory and the beginning of a detailed and comprehensive series of integrated investigations of a relatively large glacier system.

PLANS FOR THE FUTURE

It is planned to send a smaller party in 1950, possibly ten men, to continue the meteorological observations and the glaciological studies. At the end of this third field season the results will be evaluated in order to determine whether annual or less frequent observations should be made in the future. If possible, a party will be organized to make midwinter observations either in 1950-1951 or in 1951-1952.

The Society's small research station on the Juneau Ice Field is only a beginning, a symbol not only of our hope to continue detailed investigations in the years to come but also of our wish to stimulate in other individuals and institutions an active interest in these studies.

GLACIER FLUCTUATION FOR SIX CENTURIES IN SOUTHEASTERN ALASKA AND ITS RELATION TO SOLAR ACTIVITY*

DONALD B. LAWRENCE

IN RECENT years advances and recessions of glacier termini have become the subject of careful study. These oscillations have been assumed to reflect changes in weather, but study of the mechanics by which the various elements of weather favor accumulation or ablation has just begun; the nature of the possible causal agent that ultimately produces net advance or recession has remained obscure. Change in the amount of energy coming to the earth from the sun has been suspected of being a primary cause, but up to the present time there has been little concrete evidence of this, mainly because the shortness of the record of annual change in the positions of glacier termini gives us little to work with. The shortness of the weather observations available for regions where glaciers occur and the almost complete absence of such observations for altitudes where accumulation goes on have aggravated the situation. In Switzerland a sporadically kept written record of advance and recession extending back to the late sixteenth century is available,¹ but there the surfaces of accumulation are so high and precipitous that the general relation to climatic trends has not been easy to discover. In western North America the written record extends back only to 1857 at best. Fortunately, however, woody plants have kept their own age records in their growth layers, and for the past 40 years North American

* I am deeply indebted to the several organizations that provided financial aid for last summer's work, on which this report is largely based. Among these are the American Geographical Society of New York, the Office of Naval Research, the Graduate School of the University of Minnesota, and the Mazama Hardesty Trust Fund. The Alaska regional office of the United States Forest Service was most helpful in providing transportation for the work in the vicinity of Juneau, warehouse space, and numerous other conveniences. I am grateful to the many people who have aided, particularly B. Frank Heintzleman and his staff in the Forest Service, and to Maynard M. Miller, William O. Field, Jr., Kenneth N. Phillips, and William S. Cooper. Waldo Glock provided some of the literature references, and Harlan T. Stetson, Andrew E. Douglass, and the late François E. Matthes stimulated and encouraged me greatly. My deepest thanks go to my assistant, Lloyd C. Hulbert, for his enthusiasm and boundless energy in carrying on the field work, and to my wife for help in the field and with the preparation of this report.

¹ F. E. Matthes: *Glaciers*, in *Hydrology* (Physics of the Earth, Vol. 9), edited by O. E. Meinzer, New York and London, 1942, pp. 149-219 (Chap. 5), reference on pp. 204-207.

► DR. LAWRENCE is associate professor of botany at the University of Minnesota, Minneapolis, and chairman of the Subcommittee on Ecology as Related to Glacier Studies, Committee on Glaciers, Section of Hydrology, American Geophysical Union. He was leader of the plant ecology unit of the Juneau Ice Field Research Project, 1949.

tions have been reported,⁶ it is important to find out whether the basic assumptions are correct for the area under study. The technique of study depends on obtaining a sample of wood extending from bark to center as near as possible to the stem base of the oldest tree growing on the terrain being investigated. Saws and the Swedish increment borer, a form of hollow auger, are the collecting tools, and a sanding machine and microscope are used in the analysis of samples. Vertical aerial photographs, though not absolutely necessary, greatly aid the field work and the organization of the resulting data.

Periglacial terrain features in Alaska, and in other areas where glaciers occur along the Pacific coast of North America (Fig. 1) with the exception of the Prince William Sound region, present incontestable evidence that a maximum recent advance occurred a very few centuries ago and that recession has subsequently been the general rule. The most notable evidences of this are the trimlines carved in old forests by the advancing ice and the youthful character of the first-generation forests that have occupied the land freed of ice since the maximum advance. Although these features are evident to the trained observer even on foot, they would not generally be recognized by the casual traveler, because he might not guess that trees three or four feet in diameter can be less than two centuries old. However, with the aid of vertical aerial photographs for reconnaissance, even a casual observer would probably recognize the notable difference in appearance of the vegetation beyond and behind the terminal moraines and above and below the forest trimlines and the symmetrical arrangement of multiple concentric moraines within a few thousand feet or a few miles in front of the present-day ice fronts. The trained investigator is particularly fortunate in Southeastern Alaska, now that the broad coverage in 1948 by the aerial photographers of the United States Navy has become available.

There are also in Southeastern Alaska other evidences that there has been notable reduction in snow accumulation within the past century or two. At moderately high levels, 4000 to 5000 feet, in the main regions of snow accumulation there is visible on the cliffs that project above the summer snow surface a band of very light color, which represents rock until recently covered throughout the year with a continuous mantle of snow and névé, the presence of which had prevented the rock from weathering to a darker color and kept it unavailable to colonization by alga and lichen pioneers.

⁶ W. S. Glock and E. L. Reed, Sr.: Multiple Growth Layers in the Annual Increments of Certain Trees at Lubbock, Texas, *Science*, Vol. 91 (N.S.), 1940, pp. 98-99; Tarr and Martin, *op. cit.*, Plates 10B and 32A.

There is little evidence in this zone above timber line from which to ascertain the amount of time since shrinkage began. At intermediate altitudes, near 2000 feet—just below the general timber line—there is additional evidence that annual snow depth is much less than formerly. Here the floors of old cirques until recently bare of plants, or vegetated only with alpine meadow herbs that could maintain life in the brief growing season between the melting away of one year's snow cover and the beginning of the new, have been invaded successfully by shrubs and young trees that seem to require a much longer snowless season. An elfin forest of old gnarled hemlock trees extends downward from ridges part way into the cirques, but in the one carefully examined it ended abruptly, marking the high margin of the area of former short growing seasons induced by long-lasting snows that must have persisted up to perhaps a century ago. But even at these intermediate altitudes the evidence is too fragmentary to be of much use in dating the end of the years of deep, persistent snow cover in the cirques and the beginning of those of longer growing season. It is in the lowest altitudinal zone, within a hundred feet or so of sea level, that the most useful information can be gained. Here advancing glacier termini plowed into old forest, destroying everything in their paths but leaving occasional tilted trees along the forest trimline to continue growth after the last phase of the advance; and here trees become established quickly as the ice recedes. All the conclusions reported in this paper are derived from ecological studies at these low levels. Since the objective was a rather broad survey of several glaciers emanating from the Juneau Ice Field, the work was generally restricted to the study of tree age on the terrain deglaciated since the maximum of the middle eighteenth century and of the terrain just beyond the terminal moraines formed by that advance. The data for any one glacier must therefore be regarded as incomplete, and the conclusions derived from them as tentative.

With the exception of the Taku Glacier system, which has been advancing for about half a century, and a few others, most of the glaciers of South-eastern Alaska offer certain advantages not found elsewhere because they have receded a great deal farther since their recent maximum, which seems to have come to a close in the middle eighteenth century, and because a great many more recessional morainic ridges have been preserved to this day between the positions of maximum recent advance and the present ice fronts. For example, there are about twelve or thirteen clearly recognizable recessional morainic ridges between Herbert Glacier's 200-year-old terminal moraine and the present ice front, as compared with two that are recognizable between the present ice front of Eliot Glacier on Mt. Hood, Oreg., and the

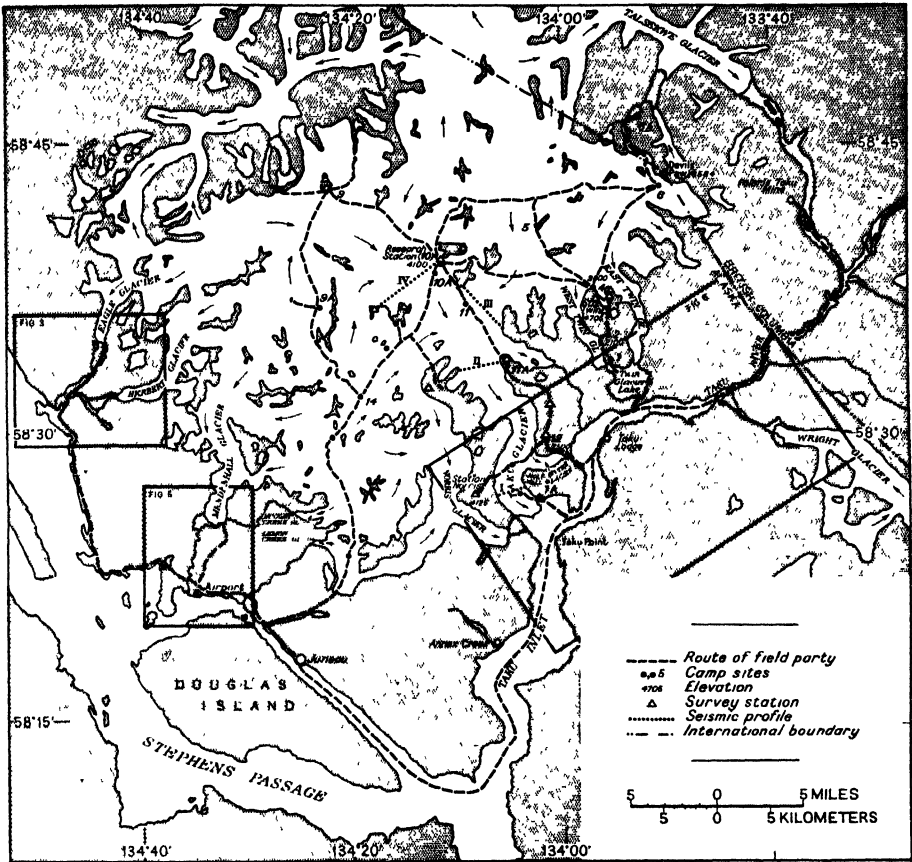


FIG. 2.—Sketch map of southern part of the Juneau Ice Field, showing principal outflowing glaciers. Routes of all field units of the Juneau Ice Field Research Project are shown. Arrows indicate direction of ice flow. The ecological work was confined to the terminal areas of the valley glaciers.

terminal moraine of 1740.⁷ In 200 years Herbert Glacier has receded two miles, Eliot two thousand feet. Each of the concentric moraines represents a time when the ice front hesitated in its recession or may even have re-advanced somewhat. The more morainic ridges there are in front of a glacier, the better is our opportunity to find out what peculiarities and possible cycles of weather cause glaciers to change their rates of accumulation and melting. The fact that the forests on the modern Alaskan glacier moraines have remained largely undisturbed by fire is also of great advantage to the student of glacier variation.

The main disadvantages in studying the Alaskan glaciers are the large areas that must be explored—for example, in Glacier Bay, where recent

⁷ Lawrence, Mt. Hood's Latest Eruption (see footnote 4, above).

recession has amounted to the world record of 62 miles since the middle eighteenth century⁸—the density of the brush, the wetness of the normal summer weather, the inaccessibility, and the high cost of transportation.

THE JUNEAU ICE FIELD

The Juneau Ice Field Research Project, of which the present work forms a part, is sponsored by the American Geographical Society. The work of the first field season (1948) has been reported in a progress report by Miller.⁹ The Juneau Ice Field is a name applied for convenience to the series of névés which occupy the crest of the Coast Range immediately north of the city of Juneau. It lies in the angle between the valley of Lynn Canal on the west and the Taku Valley and its tributaries on the south and east. The work discussed in the present report was carried out in July and August of the second field season (1949); it was restricted to the main glaciers emanating from the southwest, south, and southeast sides of the ice field (Fig. 2). The main surface of this part of the ice field forms a broad plateau about 4000 feet above the sea, punctured by scattered peaks rising to 5000 and 7000 feet. The late-summer firn line, which marks the level where annual accumulation equals annual ablation, was reported by Miller¹⁰ to lie at 3400 to 3800 feet at the end of the summer of 1948.

Let us now examine the histories of advance and recession of the individual glaciers studied last summer and consider a tentative hypothesis to explain them.

GLACIERS NORTHWEST OF JUNEAU

Herbert Glacier

Of all the glaciers surveyed, Herbert Glacier (Figs. 2 and 3), about 20 miles northwest of Juneau, is the most promising for providing further detailed information. The position of the semicircular terminal lobe that existed at the time of maximum advance in the mid-eighteenth century and the numerous regularly arranged concentric recessional moraines are plainly visible in the aerial photograph (Fig. 4). The terminal moraine is accessible within three miles by road and from there by a well-worn trail, and the trees on the moraines have grown slowly enough that complete samples of

⁸ D. B. Lawrence and E. G. Lawrence: *Some Glaciers of Southeastern Alaska, Mazama*, Vol. 31, No. 13, 1949. (In press.)

⁹ M. M. Miller: *Progress Report of the Juneau Ice Field Research Project, 1948*, American Geographical Society, New York, 1949. (Mimeographed.) See also W. O. Field, Jr., and M. M. Miller: *The Juneau Ice Field Research Project*, in this number of the *Geographical Review*.

¹⁰ *Progress Report*, p. 12.

their wood can be obtained without special techniques with the longest Swedish increment borers (15 $\frac{3}{4}$ inches) available commercially. A base camp was established in the abandoned Satko cabin by the Herbert River near the end of the Glacier Highway, and this served as a reasonably satisfactory but very moist operating headquarters for daily trips to the study areas. Detailed studies were made at stations 1-6 shown on Figure 3. All of these except

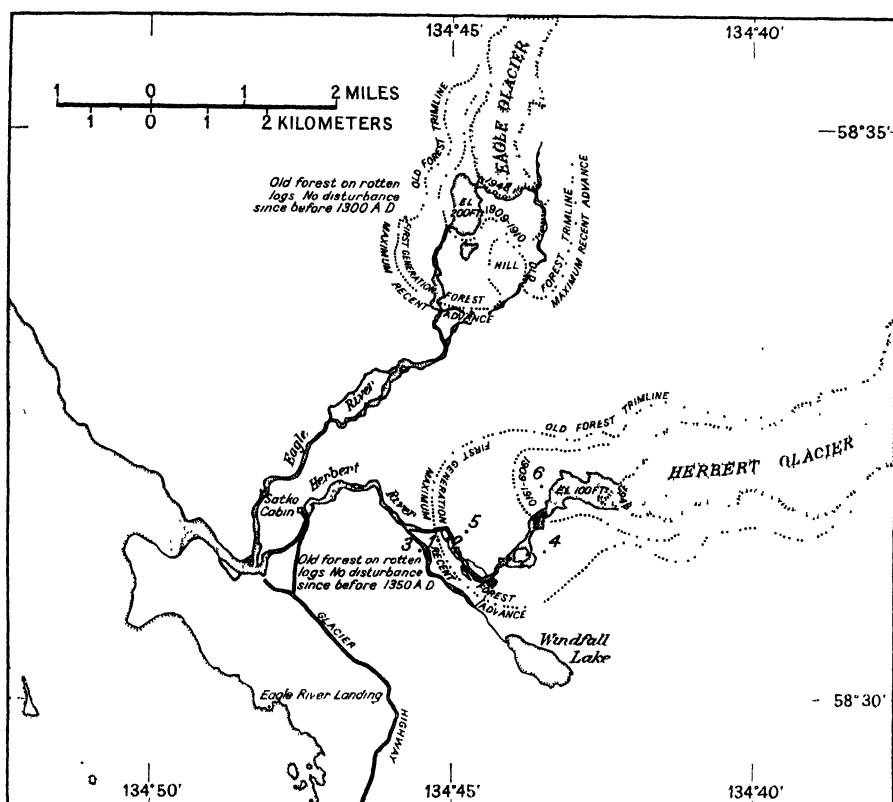


FIG. 3—Sketch map of the terminal area of Eagle and Herbert Glaciers, showing positions of maximum recent advance and 1948 termini. The numbers refer to study areas mentioned in the text. From U. S. Navy aerial photographs, 1948; control and 1909-1910 position from "Geologic Map of Eagle River Region, Alaska," U. S. Geol. Survey Bull. 502, 1912, Pl. 2, 1:62,500.

station 3 were on terrain occupied by the ice since the maximum recent advance. Studies of eleven of the oldest trees that could be found in the first-generation forest on the 20-foot-high terminal moraine at station 1 revealed that the ice must have receded from there by about 1765, but when the ice advanced to that position or how long it remained there, two miles beyond the 1948 ice front, is not yet known. The forest here was composed of an overstory of Sitka spruces 10 to 20 inches in diameter at breast height, a few

old decrepit cottonwoods 20 to 30 inches thick, and an understory of younger hemlocks 3 to 6 inches thick that constituted 40 per cent of the stand; almost no decaying logs and stumps were present, further evidence that this was a first-generation forest. Examination of the forest floor revealed 7 to 12 inches of soft, spongy organic matter overlying fresh glacier till apparently un-



FIG. 4—Eagle (left) and Herbert (center) Glaciers flowing from the Juneau Ice Field, 1942. Concentric moraines may be seen in front of Herbert Glacier; part of Lynn Canal in foreground. View east. (Trimetrogon aerial photograph by U. S. Air Force.)

weathered and undiscolored; occasional boulders 6 to 8 feet long were perched on top and were decked with a dense layer of moss.

The forest of station 3, about 1000 feet beyond the terminal moraine, presented a great contrast. It consisted mainly (95 per cent) of hemlocks of all sizes and ages, from seedlings to trees 30 inches in diameter and 300 years

old. These were perched on large old rotten logs and stumps that must have been at least 300 years old themselves before they died. Perhaps half a century elapsed between the time they died and the attainment of a state of decay sufficient to provide a satisfactory seedbed for germination of the present generation of old trees. We are therefore justified in assuming that this forest had a minimum age of 600 years; the high proportion of hemlocks to spruces would indicate that it was much older. The bedrock here is metamorphic, but it is overlain by rounded glacially transported granitoid boulders whose surfaces are stained and deeply pitted by weathering. This would seem to suggest that Herbert Glacier cannot have advanced more than 1000 feet beyond the terminal moraine of the middle eighteenth century for a long time. Six centuries is a conservative estimate; it may have been several thousand years; possibly station 3 has not been covered by ice since the waning stages of the Wisconsin glaciation.

Only two other strong moraines were sampled. If we call the terminal moraine the first one, then the third (station 2) and the eighth (station 5) were sampled. To judge from the oldest of the seven or eight largest trees that could be found at each of these stations, the ice receded from station 2 by 1786-1788 and from station 5 by 1844-1846. Stations 4 and 6 apparently do not represent moraines, but ridges of bedrock overlain by till. They became free of ice by 1887-1889 and 1920-1922 respectively. The twelve or thirteen strongest recessional moraines occur within the first half mile from the terminal moraine. Fortunately, the position of the ice front was mapped by Knopf¹¹ in 1909-1910; it is shown in Figure 3. Comparison with the position of the front in 1948 shows that half of the total two-mile recession since 1765 occurred after 1910. Just when the acceleration in rate of recession began is not known, but further field study should readily clarify that point.

Eagle Glacier

Only one day was devoted to Eagle Glacier (Fig. 3), and much of that time was expended in merely getting to it and back to the Satko cabin. We could do little sampling of tree age, but we saw nothing to lead us to believe that the history of advance and recession of this glacier is different from that of Herbert. One of the oldest of the recent recessional moraines seems to have been ice-free since about 1785-1787. Immediately above the western forest trimline we found the same evidences of a long time lapse since the last glaciation as have been described for station 3 at Herbert Glacier. An

¹¹ Adolph Knopf: *The Eagle River Region, Southeastern Alaska*, U. S. Geol. Survey Bull. 502, 1912, Pl. 1.

alder and a spruce cut at the west margin of the lake at 0.4 mile from the ice front show that this area was freed of ice about 1930–1932. The position of the ice front of this glacier also was mapped by Knopf in 1909–1910, and this is plotted in Figure 3. It is plain that half of the total recession of about 1.3 miles since the time of the maximum stage has occurred since 1910. The large hill in the center of the valley about half a mile from the present ice front is of special interest, because it formed an obstruction that divided the glacier as it moved ahead to its maximum of the middle eighteenth century. Study of the aerial photographs indicates that a fine forest trimline has been left on the slopes of this hill; if further field study should reveal the presence of old trees tilted by the ice that have continued to grow to this day, sections from these trees should enable us to learn the exact year of maximum advance.¹²

Mendenhall Glacier

For several reasons Mendenhall Glacier (Fig. 5) was the most important of our study areas for working out exact techniques for dating the terrain features found here and at the other glaciers studied in this vicinity. It had the further advantage of being within half an hour's drive from the dry convenience of our Hotel Juneau headquarters, from which daily trips were made to the area for about a week. The network of roads, a recently cut power-line right of way, and a logging operation served to reduce the manual labor involved in getting the information we needed. But most helpful of all was a series of maps of the ice front made by Mr. Charles H. Forward of the United States Forest Service regional office in Juneau, in 1931, 1933, 1936, 1940, 1945, and 1949. Copies of these maps served as a sort of "Rosetta stone" by which we could learn the exact number of years required for trees and shrubs of different kinds to germinate successfully after the terrain was freed of ice. From the charts of the positions in 1931 and 1933, we located marked survey points, and on till surfaces (stations 1, 2, and 14 of Fig. 5) that had emerged from the ice between these two years, we cut off at the very soil surface the largest woody plants we could find. We collected, in all, 31 spruces, 20 hemlocks, 18 alders, 7 willows, and 5 cottonwoods, cut sections from them, and later dried and polished these and counted their growth layers. The difference between the number of rings and the number of years since the year when the ice is known to have melted away was assumed to represent the number of years required for the

¹² Lawrence, Estimating Dates of Recent Glacier Advances and Recession Rates (see footnote 5, above).

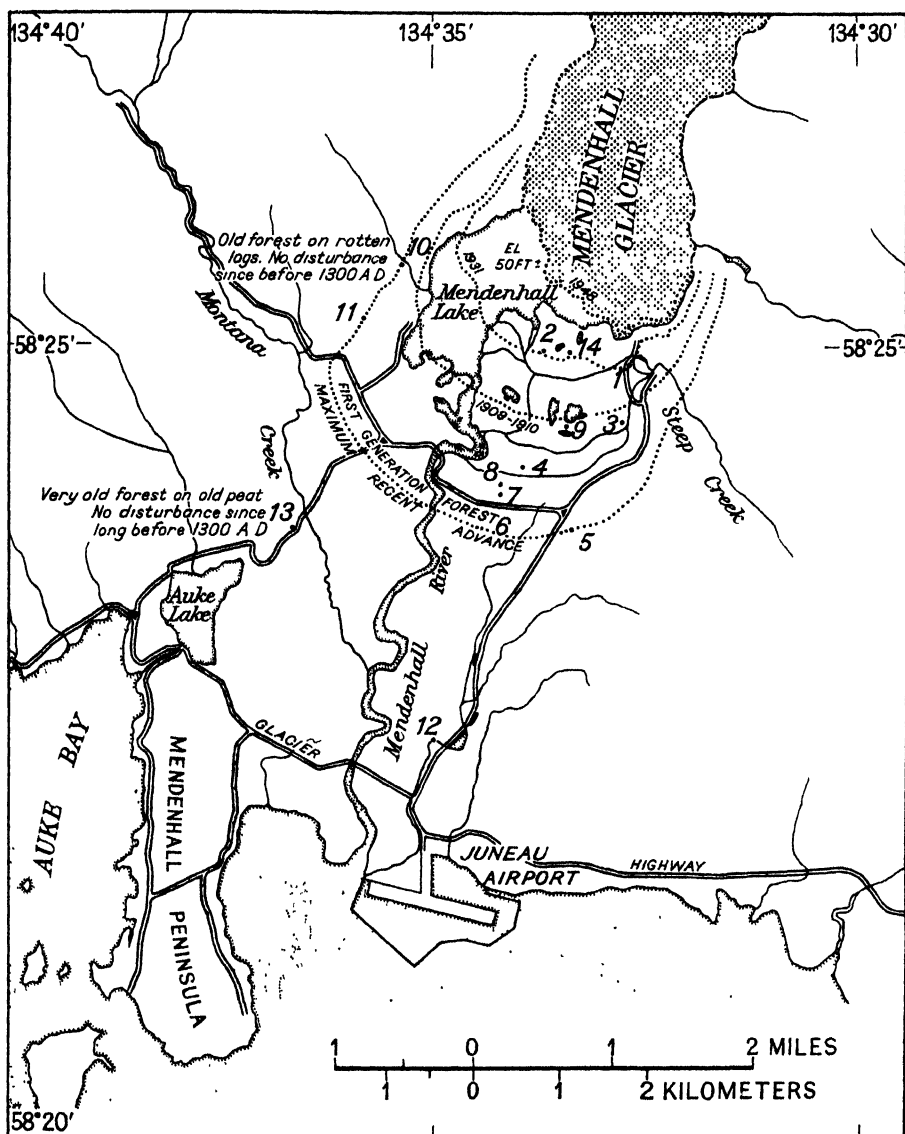


FIG. 5.—Sketch map of the Mendenhall Glacier area, showing positions of maximum recent advance and 1948 terminus. The numbers refer to study areas mentioned in the text. From U. S. Navy aerial photographs, 1948. Control from the U. S. Geological Survey's Juneau (B-2) Quadrangle, 1949; 1909-1910 position from its *Bull.* 502, Pl. 2; 1931 position from map by Charles H. Forward, U. S. Forest Service, Juneau.

substratum to become a suitable seedbed. Since the studies on the older modern moraines were of necessity being based on the Sitka spruce, because that is the only woody species present throughout the first 200 years of the forest development, we devoted most attention to this species.

Analysis of our ring counts from the stem bases of the sapling spruces revealed that the usual interval between the melting away of the ice and successful germination was three to five years in the slight depressions and five to seven years on the ridgetops, and these values were applied as corrections to ring counts of spruce throughout the study. The facts that the ring counts so nearly corresponded with the known number of years elapsed since the ice melted away and that in no case was the number of basal rings greater than the number of years of freedom from ice provide good evidence that the rings of the trees of this region are really annually produced and thus may be accepted as a reliable index of time. Two other forms of evidence support this view: (1) all the rings are invariably complete; and (2) cross-dating between trees growing 10 to 25 miles apart is readily possible. Since it is usually impossible with a Swedish increment borer, and often difficult with a saw, to obtain a sample of wood of the larger trees at the very stem base, we were interested in working out also values for correcting ring counts at various heights above the surface of the parent soil material on which the seed germinated. All spruces cut at these stations and some collected at Herbert Glacier station 6 were therefore sectioned at 6, 12, 18, 24, and 30 inches above the stem base as well as at the base. Though we found that there was a good deal of variation in the number of years required for growth to a given height, and that the greatest variation was within the first 6 inches, the usual period for attaining the 6-inch height was 5 years, for 12 inches 7 years, for 18 inches 8 years, for 24 inches 9 years, and for 30 inches 10 years. These values were used in correcting ring counts throughout the study except at Twin Glaciers in the Taku Valley, where the rate of diameter growth had been so rapid that it seemed justifiable to assume that a height of 16 inches was attained in only 3 years instead of 7 or 8.

At Mendenhall, as at Herbert, not every moraine was sampled, so that further field work will be necessary to fill in the details. The similarity to conditions at Herbert was again strong, and there is no reason to believe that the history has been very different. The total recession since the middle eighteenth century has been two miles, and half of that has occurred since the position plotted by Knopf in 1909-1910 (Fig. 5). The 1931 position plotted by C. H. Forward stands about halfway between that of 1909-1910 and that of 1948, an indication of a rather uniform rapid rate for the past 40 years.

The rapidity of this most recent recession is in fact the reason for the guess, rather widely accepted by the local population, that the Mendenhall Glacier terminus has receded from tidewater at Gastineau Channel within

the past 200 years. Even Wentworth and Ray¹³ believed that both this glacier and Herbert "have only recently retreated from the coast." This guess cannot be true, however, because at station 12 on an outwash surface spruces were growing as early as 1680. More convincing still, at station 13 are living trees at least 630 years old, which would most certainly have been overwhelmed by ice if Mendenhall Glacier had advanced even to within two miles of Gastineau Channel. As a matter of fact, the forest at station 13 presents more convincing evidence of great age than the forests outside the areas of recent glacier disturbance at Herbert and Eagle Glaciers. At Mendenhall station 13 the forest is a mixture of ancient lodgepole pine, hemlock, and occasional spruce; the forest floor consists of waterlogged peat of untested depth. This vegetation seems to be in an intermediate successional stage between old hemlock forest and the muskeg which Zach¹⁴ suggests may be the true regional climax on this gently sloping terrain. The oldest tree sampled here, a Sitka spruce, only 18 inches in diameter at the surface of the peat, was cut to provide a power-line right of way beside the road in 1948. The center ring was formed about A.D. 1319. The extreme narrowness of the growth layers even near the center shows conclusively that this tree cannot possibly have been a member of the first generation of forest which grew on this surface. The species composition and the presence of peat indicate that many forest generations must have passed before the present condition could exist.

Spruces sampled at station 6, in the middle part of the terminal moraine of maximum recent advance, show that deglaciation occurred about 1767-1769, whereas at station 5, near the east margin, the ice remained until 1786-1788 and deposited on top of the 12-foot-high moraine ridge some monstrous boulders, one 24 feet long and 9 feet high. At station 10, on the west lateral moraine just below trimline, deglaciation had occurred by 1772-1774. At station 11 an extensive wind throw about 1882-1883 tilted many trees; the first impression was that they had been tilted by advancing ice, but they were found to occur both above and below the lateral moraine and trimline.

Within the area deglaciated since the modern maximum, the moraine at station 7 was ice-freed about 1832-1834, the next younger moraine at station 8, which unites with the older one at both ends, was ice-freed about 1865-1867. There is evidence in tilted trees at station 7 that a readvance occurred between 1832 and 1865, perhaps overrunning moraines formed in

¹³ C. K. Wentworth and L. L. Ray: Studies of Certain Alaskan Glaciers in 1931, *Bull. Geol. Soc. of America*, Vol. 47, 1936, pp. 879-934; reference on p. 885.

¹⁴ L. W. Zach: A Northern Climax, Forest or Muskeg?, *Ecology*, Vol. 31, 1950. (In press.)

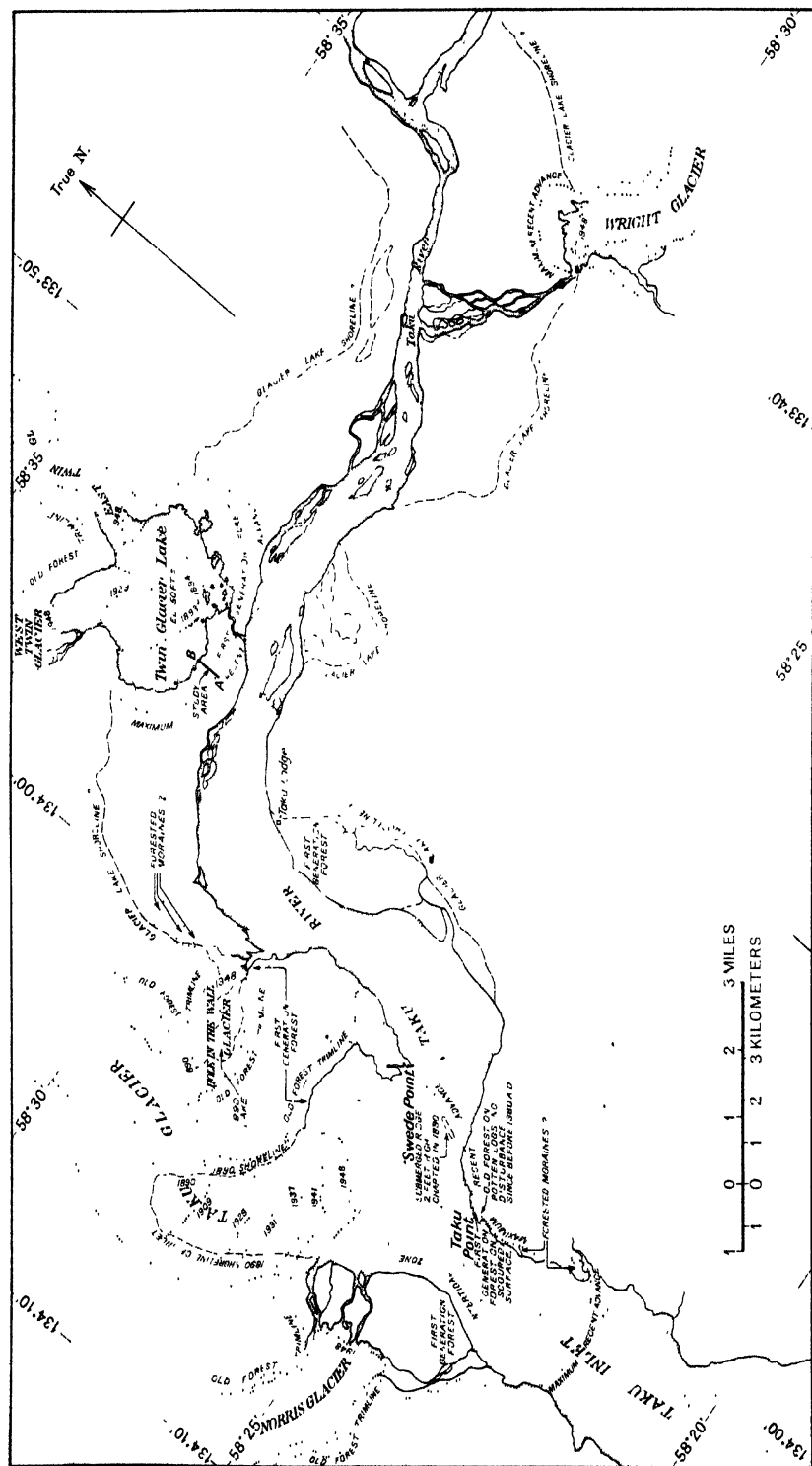


Fig. 6—Sketch map of lower Taku River area showing 1948 positions of several glaciers and positions at other dates estimated from several sources. Note the ice dam of the Taku River formed by advance and coalescence of Norris and Taku Glaciers in the middle 1700's and the extent of the lake thus formed; the strong present readvance of Taku and Hole-in-the-Wall Glaciers; the extensive recession of Norris and the Twin Glaciers; and the minor recession of Wright Glacier. From United States Navy aerial photographs, 1948; approximate control from existing maps

the interim. The moraines at stations 4 and 9 were freed of ice about 1883–1885 and 1901–1903 respectively.

According to Wentworth and Ray¹⁵ there are at both Mendenhall and Herbert Glaciers, in the area between the present ice fronts and the terminal moraines of maximum recent advance, occasional old stumps, the remains of trees that grew there before the recent advance. If the advance killed them within the past 300 to 500 years, their contemporaries are still alive today above the trimline and farther down the valley, and it may be possible to cross-date the ring patterns of the old stumps with those of the old trees living in the vicinity today and discover just when and at what rate the recent advance took place. If it occurred more than 500 years ago, a fairly close estimate of the date may be obtained by analysis of the radioactive carbon content of the old stumps by the technique described by Arnold and Libby.¹⁶

GLACIERS OF THE TAKU VALLEY

Fifteen miles above the mouth of Taku Inlet (Fig. 2) a most unusual sight greets the eye (Figs. 6–8). Emanating from the same ice field, and with termini side by side and less than a mile apart in 1948 and 1949, lie two glaciers, Norris and Taku, the first receding, the second advancing. We have sufficient historical data to know that Taku has been advancing since at least 1900 and that Norris, after a period of minor fluctuations, has been receding since about 1916. The activity of Norris Glacier, then, is more nearly normal, to judge from the glaciers already discussed; that of Taku and its distributary arm, Hole-in-the-Wall Glacier (to be considered later), most abnormal.

Norris Glacier

The periglacial terrain features between the Norris ice front and Taku Inlet were studied in 1941, and since tree-ring material was collected at that time, the area was not revisited last summer. The terrain consists chiefly of an extensive outwash apron, parts of which adjacent to the inlet must have been deglaciated as early as 1828–1830. Periodic outbreaks under the ice of a lake along the flank of the glacier above its terminus, which have been occurring at least since 1916 (personal communications from W. S. Cooper and Louis DeFlorian),¹⁷ have kept much of the outwash fan so un-

¹⁵ Wentworth and Ray, *op. cit.*, pp. 888, 891.

¹⁶ J. R. Arnold and W. F. Libby: Age Determinations by Radiocarbon Content: Checks with Samples of Known Age, *Science*, Vol. 110, 1949, pp. 678–680.

¹⁷ See also Wentworth and Ray, *op. cit.*, p. 894.



FIG 7—Norris Glacier (left) and Taku Glacier (right) from Pond cabin just west of Taku Point, as they appeared in August, 1916 (Photographs by William S Cooper)

FIG 8—View from within 100 feet of Pond cabin (see Fig 7) 33 years later showing recession of Norris Glacier and advance of Taku Glacier, August, 1949 (Photographs by the author)



FIG 9 (upper left)—The scoured surface of Taku Point over which the Taku River must have poured when the Norris Glacier, out of view at left and the Taku Glacier left center extended across the river to form an ice dam Old forest at right stands beyond and above the eighteenth-century limit of ice advance [The altitude of the old forest trimline here is about 100 to 150 feet above sea level] August, 1949 (Photograph by the author)

FIG 10 (upper right)—One of the earliest photographs of Taku Glacier 1893 (Believed to be from Canadian Boundary Survey)
FIG 11—Forest wreckage, uprooted by the advancing ice, along east margin of Taku Glacier Although these trees are large, the forest is in its first generation and none of the trees sampled predate 1790 August, 1941 (Photographs by the author)

stable that forest development has not advanced beyond pioneer stages except in a few small areas. The only ridge that has been surely identified as a moraine lies 0.3 to 0.4 mile ahead of the 1948 ice front. This seems to have been formed by a slight advance, the peak of which, estimated from tree rings, must have occurred before 1916-1918 but after 1878-1880. Field states (personal communication) that "a comparison of early photographs indicates that in the 1880's the glacier was close to or in contact with the trees along the margins. In 1906 the Wrights found it advancing and this culminated between 1910 and 1916." A description by Vancouver¹⁸ suggests that the Norris still had a vertical tidal icefront in 1794, since there were then "immense bodies of ice (glaciers) that reached perpendicularly to the surface of the water in the basin which admitted of no landing place for the boats," and that there was a great deal of floating ice, especially at the entrance of the inlet, through which "a passage was with difficulty effected."

Although much more detailed field work should be done here, evidence is already available to indicate that in the middle of the eighteenth century Norris Glacier, in coalescence with its neighbor Taku Glacier, extended across Taku Inlet to Taku Point, three miles beyond its 1948 terminus. This evidence consists of two fragments of what appear to be moraine ridges south of Taku Point (Fig. 6), a forest trimline that stands 100 to 150 feet above tidewater on Taku Point, against which Norris Glacier must have pushed, and a heavily scoured region between that trimline and the inlet, over which the Taku River must have flowed when the tip of the ice dam rested there. At Taku Point (Figs. 6, 9) a first-generation forest that began to grow about 1755-1757 stands immediately below the trimline, and a very old forest perched on rotten logs and surely undisturbed since 1390 or earlier stands above the trimline.

Taku Glacier

For many years before the early 1940's Taku Glacier was probably the best-known glacier in Alaska, because in those days the head of Taku Inlet was still deep enough to admit large tourist ships. More recently, however, as the ice has continued to advance, the inlet has become silted, so that only shallow-draft vessels can approach it closely. In 1890, Taku Inlet was carefully charted by the United States Coast and Geodetic Survey under the supervision of Lieutenant Commander H. B. Mansfield, and the outline of the inlet and the position of the ice front of Taku Glacier as shown on the chart

¹⁸ Pacific Coast Pilot: Alaska, Part I, Washington, 1883, p. 170 (citing Vancouver, official edit., Vol. 3, p. 278).

have been transferred to the sketch map (Fig. 6), so that a comparison of the 1890 and 1948 positions can be readily made. Photographic confirmation of the great advance since the 1890's is seen in Figure 9. According to Field (personal communication) "in 1890 I. C. Russell visited Taku Glacier and recorded the impression that it was retreating. In 1903 H. F. Reid referred to a report that the glacier had been greatly affected by the earthquake of 1899 but that the resulting losses were then being made up. By 1904 a net advance had occurred. I know of no evidence that the present advance began before 1899 and I believe if it did, that it is quite possible that the loss of ice in the earthquake in that year nullified the advance so that it started again from the 1890 position about 1900." It is estimated, therefore, that Taku has advanced about $3\frac{1}{2}$ miles in 48 years. If this rate is continued for another 32 years, the remaining two-mile gap between the terminus and Taku Point will be closed up, and again an ice dam will block the Taku River as it must have in the middle eighteenth century. It has been stated in the literature¹⁹ that Taku Glacier was in a more advanced position in 1935 than it had been for many centuries, and indeed the large size of the individual trees at the edge of the ice led me to the same conclusion after superficial observation in 1941. But now I must contradict that idea; for careful sampling of the forest, into which the ice was plowing (Fig. 11) along its north margin last summer, revealed that it is a first-generation forest of spruces and hemlocks without rotten logs and stumps, and that the time when the ice of the last recent advance melted away in that area must have been as recent as about 1771.

The evidence on Taku Point described for Norris Glacier holds for Taku Glacier also. The whole tip of Taku Point below an altitude of 100-150 feet is heavily scoured (Fig. 9), and it seems to have formed both abutment and spillway of a gigantic ice dam derived from both Taku and Norris. Additional confirmatory evidence of the extent of that recent advance by Taku is found in the submerged ridge (Fig. 6) lying across the mouth of the Taku River north of Taku Point in 1890,²⁰ since this is assumed to have constituted a part of the terminal moraine of the middle eighteenth century. The oldest trees immediately below the trimline show that overflow from the ice-dammed Taku Lake must have begun to cross the higher scoured parts of Taku Point by about 1755-1757. The lake surface must have been lowered below an altitude of some 50 feet above sea level by about 1775, because by

¹⁹ Matthes, *op. cit.* (see footnote 1, above), p. 201.

²⁰ "Taku Inlet, S. E. Alaska. By the party unter [*sic*] the charge of Lieut. Comdr. H. B. Mansfield . . . 1890." 1 : 40,000. U. S. Coast and Geodetic Survey hydrographic survey, photostatic reproduction.



FIG. 12 (upper left)—Hole-in-the-Wall Glacier in August, 1934. Still visible at the tip of the ice is remnant of the lake which was 1.2 miles long in the 1890's, before the present glacier advance occurred. Taku Glacier flows from right to left in background; Taku River and tidal flats in foreground (U. S. Navy aerial photograph.)

FIG. 13 (upper right)—Hole-in-the-Wall Glacier in 1949, showing 15-year advance. (Photograph by the author.)

FIG. 14 (lower left)—Hole-in-the-Wall Glacier in August, 1941. (Photograph by the author.)

FIG. 15 (lower right)—View from approximately the same position as Figure 14. August, 1949. The glacier has advanced over the 200-foot cliff onto the tide flat. (Photographs by the author.)

then trees had begun to grow 10 miles upstream on parts of the terminal moraine of Twin Glaciers, which had apparently been deposited below the lake surface. The shore line of the glacier lake as roughly identified from the aerial photographs is shown in Figure 6, and it will be noted that the whole terrace on which Taku Lodge is built was then lake floor. The forest on that terrace is in a young stage of the first generation.

To review the complex history of Taku Glacier, then, we may infer that it advanced along with all the others already described, to a maximum sometime in the middle eighteenth century, and then began to recede along with the others. This part of its history was normal, but by 1900 at the latest a readvance began that has continued to the present time. The total recession from the position of maximum recent advance must have amounted to more than five miles, before the readvance began. Just what caused this glacier to begin advancing after receding extensively is not fully known. The extent to which its readvance may have hastened the recession of the other glaciers feeding from the same ice field, through "snow piracy," may be discovered at higher levels by study of the degree of competition among these glaciers for snow from a source that is shared by the Taku.

Hole-in-the-Wall Glacier

Sometime between 1888 and 1906, when the surveying was done for United States Coast and Geodetic Survey Chart 8300,²¹ Hole-in-the-Wall Glacier did not exist at all (Fig. 6), and its present bed was occupied by a lake about 1.2 miles long. Since then it has advanced onto the tide flats of the lower Taku River. Any satisfactory explanation of the recent readvance of Taku Glacier would serve to explain the behavior of Hole-in-the-Wall, since it is a distributary arm of Taku. Figures 12 to 15 show various stages in its advance since 1934. As far as can be judged from the trees growing along its margin today, its history is one of advance to a maximum in the middle eighteenth century followed by normal recession. At an unknown time it began readvancing. It is advancing today into a very sparse first-generation forest, the age of whose individuals indicates that recession from the last maximum was in progress by about 1790-1792. Just how far it advanced in the middle eighteenth century is not yet known, but three parallel forested ridges rising out of the tide flats 1.5, 1.0, and 0.7 miles beyond the 1948 ice front (Fig. 6) appear much like moraines on the aerial photographs.

²¹ "Lynn Canal and Stephens Passage, S.E. Alaska," 1:200,000, U. S. Coast and Geodetic Survey Chart No. 8300, 1906.

Twin Glaciers

Perhaps the most spectacular glaciers of the lower Taku Valley are the Twin Glaciers (Fig. 6), which end in a lake three miles across. Their history is obviously similar to that of Herbert and Mendenhall and is not complicated by present readvance, as in the case of the Taku. The total recession since the stage of maximum recent advance in the middle eighteenth century, when there was a large semicircular terminal lobe, had amounted by 1948 to 3.3 miles for West Twin and 2.5 miles for East Twin. The difference may reflect effects of recent snow piracy by the Taku, whose feeding ground is much more closely associated with West Twin than East. Twin Glaciers Lake was found to be at least 447 feet in depth, and according to historical records²² it was still completely filled with ice in 1893-1894. The position of the edge of the ice as recorded then is shown in Figure 6, though a large area which must have been debris-covered ice has since melted out and increased the size of the lake. I saw evidence in 1941 that melting was still going on—small islands recently sunk below the surface of the lake bearing drowned young spruces. In a photograph taken in 1923, East and West Twins are still joined in a common bulbous tip, with giant bergs, some apparently more than a mile long, floating in the lake. According to Field (personal communication), the two glaciers were still joined at their termini when he visited the area briefly in 1926, but an aerial photograph taken by the United States Navy in 1929 shows two termini separated by a distance estimated at a few hundred feet.²³

Detailed work on the age of moraines formed since the maximum recent advance was carried on last summer along the line A-B in Figure 6. The trees on the terminal moraine had grown to very large size, some as much as 46 inches in diameter at breast height, so that a special technique using a socket-wrench extension to our borers was devised by Hulbert for collecting cores all the way to the center. The oldest trees tested in this way showed that the 14-foot-high terminal moraine must have been freed of ice by about 1775-1777. The ridgetop here bore a mantle of what seemed to be lake silt; a machete blade could be thrust into it to a depth of six to eight inches below the bottom of the organic layer without striking any pebbles. Since we studied the Twin Glaciers area before the Taku Glacier and Taku Point areas, this was our first intimation that the Twin Glaciers moraine must have been formed under the surface of a water body; investigation of the Taku

²² Boundary Atlas of Alaska, 1893-1895, Survey Sheet No. 12.

²³ Wentworth and Ray, *op. cit.*, p. 895.

Lodge terrace disclosed further evidence that sent us on to Taku Point in search of final confirmation. Later we learned of a local Indian legend that mentioned a lake formed by a dam across the river near Taku Point.

At the Twin Glaciers study area all the moraines along the line A-B were sampled, and the years of deglaciation were found to be 1775-1777, 1788-1790, 1800-1802, 1835-1837, 1844-1846, 1857-1859, 1869-1871, and 1877-1879. The oldest trees that could be found on the level shore of the lake indicate that the subaerial history of that surface does not precede about 1881-1883.

Wright Glacier

We did no ground work on the terrain in front of Wright Glacier. To judge from the aerial photographs, its position of maximum advance was only 0.7 mile beyond the 1948 ice front, and the position of the apparent shore line would suggest that the terminal moraine was formed under water, as it was at the Twins. Much difficult ground work will need to be done here before we can arrive at any sound conclusions regarding the history of this glacier, which emanates not from the Juneau Ice Field but from an entirely different ice field to the south of the Taku Valley (Fig. 2).

A TENTATIVE HYPOTHESIS ON RECENT GLACIER PERIODICITY IN NORTHWESTERN NORTH AMERICA

In the results that have been presented here, one notable feature stands out. That is the synchronism, for all the glaciers studied, of an advance of the termini to positions of maximum extent in the early or middle eighteenth century and the beginning of recession by about 1765. It is true, of course, that these glaciers all emanate from the same broad ice field, so that uniformity of behavior in this respect would be expected. But the synchronism with the glaciers of the Glacier Bay area, 65 miles to the northwest,²⁴ those of Garibaldi Park (W. H. Mathews, personal communication), 800 miles to the southeast, and of Eliot Glacier on Mt. Hood,²⁵ 1100 miles to the southeast, and even glaciers of Norway and Iceland,²⁶ can hardly be assumed to be merely coincidental. The similarity reported in the periglacial features of Nisqually Glacier on Mt. Rainier (Arthur Johnson, personal communication) and Coleman Glacier on Mt. Baker (K. N. Phillips, personal communication) leads me to believe that their histories have been similar also. Even the

²⁴ Cooper, *op. cit.* (see footnote 3, above), p. 47.

²⁵ Lawrence, Mt. Hood's Latest Eruption (see footnote 4, above).

²⁶ Matthes, *op. cit.* (see footnote 1, above), pp. 207-208.

morainal features of North Iliamna Glacier on Iliamna Volcano, 700 miles northwest of the Juneau Ice Field, seem similar (Bradford Washburn, personal communication)²⁷ to those just examined. Only some of the glaciers of the Prince William Sound region, 500 miles northwest of the Juneau Ice Field, and of a few other areas on this continent, have behaved in a significantly different way (W. O. Field, personal communication; see also footnotes 39 and 40, below). Surely some widespread climatic event must have been the reason for the concordant behavior of glaciers so widely spaced geographically.

Unfortunately, no weather records for this region extend back far enough to be useful for comparison with glacier behavior at the time of the maximum recent advance in the middle eighteenth century. There are, however, well-documented records of relative sunspot numbers extending back to 1610, when careful systematic observations of the sun's surface through telescopes began.²⁸ Many workers have pointed to close correlations between visible evidences of solar activity (relative number and position of sunspots) and the incidence of various terrestrial phenomena. Best known of the correlations occur between relative sunspot number, particularly below a certain solar latitude, and magnetic disturbances, auroras, and radio transmission. Sunspot curves and curves of annual growth in trees have also been shown to be related. Correlations with weather have been convincingly demonstrated, but apparently these have been particularly perplexing to the layman because the sign and the closeness of the correlation for at least some of the elements of weather seem to depend on the latitude and longitude of the part of the earth under consideration. Clayton²⁹ has been most careful to emphasize this; he has indicated that in the North Pacific coastal region of North America the correlation between sunspot number and winter barometric pressure is high and positive. Consequently, during periods of high sunspot number, glaciers should shrink through the operation of the following meteorological conditions, particularly on south-facing slopes that receive insolation most efficiently: increased frequency of northerly winds bringing clear skies, admitting a greater amount of sunshine—presumably most intense at this stage of the cycle—to the ice fields and glaciers, and

²⁷ See also Washburn's aerial photograph of this glacier on page 669 of F. B. Colton: *Weather Fights and Works for Man*, *National Geogr. Mag.*, Vol. 84, 1943, pp. 641-670.

²⁸ The Chinese, however, had been observing sunspots with the naked eye since 28 B.C. See Co-Ching Chu: *Climatic Pulsations during Historic Time in China*, *Geogr. Rev.*, Vol. 16, 1926, pp. 274-282; reference on p. 280, footnote 5.

²⁹ H. H. Clayton: *Solar Relations to Weather and Life*, 2 vols., Canton, Mass., 1943; reference in Vol. 2, p. 367 (Fig. 12).

thereby increasing ablation while at the same time decreasing the amount of snowfall. Conversely, during periods of low sunspot number, the frequency of southerly winds should increase, bringing greater cloudiness and thus decreased ablation and increased snowfall, causing glaciers to accumulate more rapidly than they melt, with a resultant net advance at the terminus, or perhaps merely a cessation in shrinkage or a reduction in the rate of recession. It was with great interest therefore that while reading

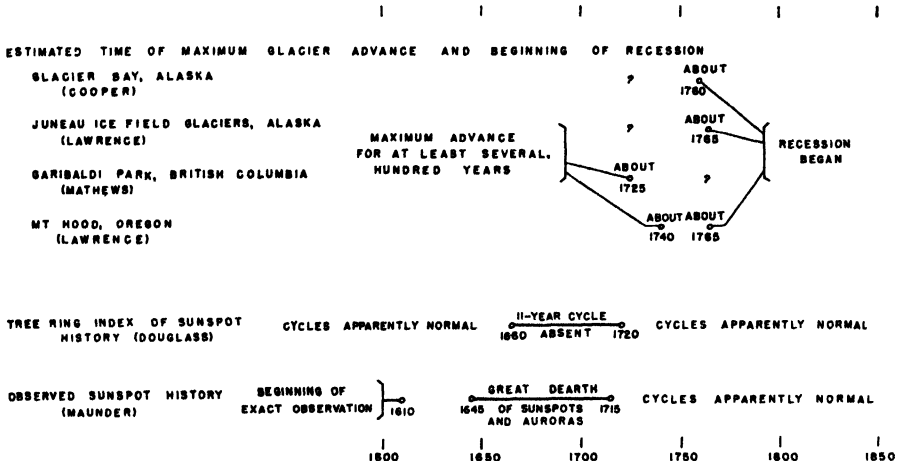


FIG. 16—Relation of the strongest glacier advances in northwestern North America for at least the past six centuries to the period of great sunspot dearth, 1645–1715.

Stetson's "Sunspots in Action"³⁰ I stumbled on the fact that two workers, Maunder and Douglass,³¹ had independently assembled evidence pointing to a period of great sunspot dearth 60–70 years long that closely preceded the time of maximum recent glacier advance in Alaska, Oregon, and British Columbia. The concordant results of the Juneau Ice Field studies reported here are strong evidence of the significance of this interesting correlation (Fig. 16).

THE PROLONGED SUNSPOT MINIMUM OF 1645–1715

The most comprehensive, though not the earliest, report of this phenomenon was prepared by the late Professor E. Walter Maunder³² of the

³⁰ H. T. Stetson: *Sunspots in Action* (Humanizing Science Ser.), New York, 1947.

³¹ E. M. Maunder: The Prolonged Sunspot Minimum, 1645–1715, *Journ. British Astronom. Assn.*, Vol. 32, 1921–1922, pp. 140–145; *idem*: The Sun and Sunspots, 1820–1920, *Monthly Notices Royal Astronom. Soc.*, Vol. 82, 1922, pp. 534–543.

A. E. Douglass: *Climatic Cycles and Tree-Growth*, 3 vols., *Carnegie Instn. Publ. No. 289*, 1919–1936.

³² The Prolonged Sunspot Minimum (*op. cit.*). Maunder's articles (see footnote 31) mention early reports by Rudolf Wolf (no date), F. W. G. Spoerer in 1889, and his own brief notes of 1890, 1894, and 1896 commenting on the Spoerer articles.

Royal Observatory, Greenwich, England. He pointed out that for the first 35 years after 1610, when sunspots were first seen by Galileo through his new telescope and a careful systematic record of their numbers was begun by Galileo and Scheiner (1611), the periodicity of spottedness seems to have been normal, with minima in 1619 and 1634 and maxima in 1625 and 1639. But from 1645 to 1713 almost no spots were observed, and those seen were all in the sun's southern hemisphere.³³ In 1714-1715 many spots appeared in high latitudes in the northern hemisphere, and in 1716 spots were plentiful. In Maunder's own words:

Thus for close upon 70 years, the ordinary progress of the solar cycle, as we have been accustomed to it was in abeyance—in abeyance to such a degree that the entire records of those 70 years combined together would scarcely supply sufficient observations of sunspots to equal one average year of ordinary minimum such as we have been accustomed to during the past century.

He pointed out that the dearth must have been real and not due to inadequate equipment, because the telescopes then were more powerful than those used by Galileo and Scheiner in their discovery. Nor were observers few: sixteen qualified men were watching for sunspots during this period. Maunder further emphasized:

It ought not to be overlooked that, prolonged as this inactivity of the Sun certainly was, yet the few stray spots noted during the seventy years' dearth,—1660, 1671, 1684, 1695, 1707, 1718,—correspond, as nearly as we can expect, to the theoretical dates of maximum . . . so the above-mentioned years seem to be marked out as the crests of a sunken spot-curve.

He quoted from Miss Agnes Clarke's report that there was strong but indirect evidence that the prolonged sunspot minimum was attended by a profound magnetic calm; for in England not an auroral glimmer was chronicled in the whole seventeenth century, and even in Iceland and Norway they became so rare as to be considered portentous, and their reappearance at Copenhagen in 1709 was greeted with consternation and amazement.

Meanwhile, unaware of Wolf's or Spoerer's reports (1889) and Maunder's publications of 1890, 1894, and 1896, A. E. Douglass of the University of Arizona had been having more trouble over the interval 1660-1720 than over any other in working out the action of the sunspot cycle in the growth layers of yellow pines. Nevertheless, in 1919 he published his results,³⁴ with mention that "for the next 60 years [following 1660] the curve flattens out in a striking manner." He finally concluded that, "taking the evidence as a whole, it seems likely that the sunspot [11-year] cycle has been operating since

³³ I do not know whether this marked asymmetry of solar activity has any bearing on the case; it is given merely as a matter of record.

³⁴ Douglass, *op. cit.* (see footnote 31, above), Vol. 1, p. 102.

1400 A.D., with some possible interference for a considerable interval about the end of the seventeenth century." In 1928³⁵ he described with enthusiasm the historical confirmation of his period of sunspot dearth. He stated that in 1914 he had nearly given up the idea that the trees showed the 11-year cycle. The first confirmation came in 1922, in the form of a letter from Professor Maunder "calling attention to the prolonged dearth of sunspots between 1645 and 1715, and saying that if there were a connection between solar activity and the weather and tree-growth, this extended minimum should show in the weather and in the trees." Douglass immediately recognized this interval as the one in which "there was entire failure in attempting to trace effects of the well-known solar cycle." He subsequently found that further confirmation existed in the sequoia record and also in the Vermont hemlocks and in other tree records, and that nothing similar to this dearth period had occurred "for hundreds of years" before the seventeenth century.

Confirmatory evidence of this period of abnormal conditions of sun and weather is found in a graph³⁶ of the frequency of severe winters based on old historical records, which indicates that the greatest frequency from the beginning of the record in about A.D. 300 to about 1760 occurred in the seventeenth century.

MORAINE FORMATION AND SUNSPOT MINIMA OF THE "11-YEAR CYCLE"³⁷

Figure 17 shows a most interesting correlation between the dates of deglaciation as worked out from the oldest trees sampled on the moraines and the years of observed sunspot minima. The correlation at Herbert Glacier seems most exact. Further work, particularly on the Herbert moraines, where the record seems most regular and complete, may confirm my supposition that during each sunspot minimum in a general period of recession the glacier terminus hesitated long enough to deposit a ridge of till. A less exact correlation is apparent for the sampled Mendenhall moraines. The correlation at Twin Glaciers is high if we assume, as mentioned in the discussion of Mendenhall Glacier, that the young trees grew to the sampling height four years faster than at Herbert and Mendenhall, thereby in effect sliding the estimated dates of deglaciation four years to the left for all (correction made before plotting).

³⁵ *Ibid.*, Vol. 2, pp. 125-126.

³⁶ H. W. Clough: The 11-Year Sun-Spot Period, Secular Periods of Solar Activity, and Synchronous Variations in Terrestrial Phenomena, *Monthly Weather Rev.*, Vol. 61, 1933, pp. 99-108, Fig. 2 (on p. 102).

³⁷ I place the length of the cycle in quotation marks because this value is merely an approximate average; the length between minima has ranged from 9 years to 14 years within the period of most careful observation, which began in 1749 (see Stetson, *op. cit.*).

The 20-year moving mean of sunspot numbers is plotted across the middle of Figure 17 in order to smooth the curve and give some idea of the trend of spottedness during the period of observation. It will be noted that there are general lows in the early and late nineteenth century and the early twentieth, and one would therefore expect the frequency of occurrence of

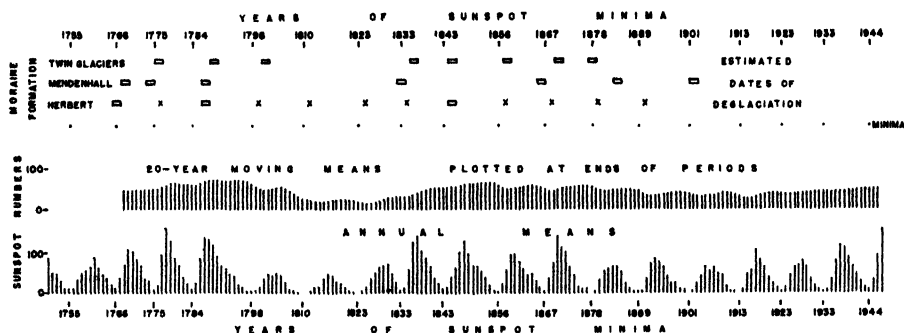


FIG. 17—Suggested relation of moraine formation to time of sunspot minima. Sunspot numbers are graphed at the base as annual means, from H. T. Stetson's tables published in "Sunspots in Action," and in the middle as moving 20-year means calculated by Elizabeth G. Lawrence from the Stetson data. The estimated times of deglaciation of the moraines studied, based on oldest trees found on each, are plotted above as open rectangles; x's indicate the suspected time of deglaciation of existing but unsampled moraines. It is notable that the number of existing moraines does not exceed the number of sunspot minima and that the estimated times of deglaciation usually coincide with, or shortly follow, the years of sunspot minima.

slight glacier advances to be higher toward the ends of those periods than at other times, but the correctness of this assumption must also await further field study.

The history of the places sampled at both Mendenhall and the Twins is obviously complicated by advances in the nineteenth century, but the history at Herbert does not seem to be complicated in that way. My interpretation of the morainal history of these three glaciers, based on the field work done so far, is shown diagrammatically in Figure 18, in which the assumption is made that a moraine would be produced for each occurrence of sunspot minima. Unfortunately, there still seem to be more question marks than known facts, but I present it as a framework for testing the tentative hypothesis that, for this general region and during a period of general recession such as we have experienced since the maximum recent advance of the middle eighteenth century, moraine formation is related to the occurrence of sunspot minima.

Since all the moraine dating reported here is based on the time of germination of woody plants, particularly Sitka spruce, on surfaces just freed of ice, it might be argued that the periodicity of moraine formation shown

in Figures 17 and 18 could be due entirely to a periodicity in production of seed crops, which might in turn depend on the "11-year" solar cycle. But data provided by United States Forest Service personnel indicate that this objection is not justified. Dr. R. F. Taylor of the Forest Research Center in Juneau indicates (personal communication) that some Sitka spruce seed is

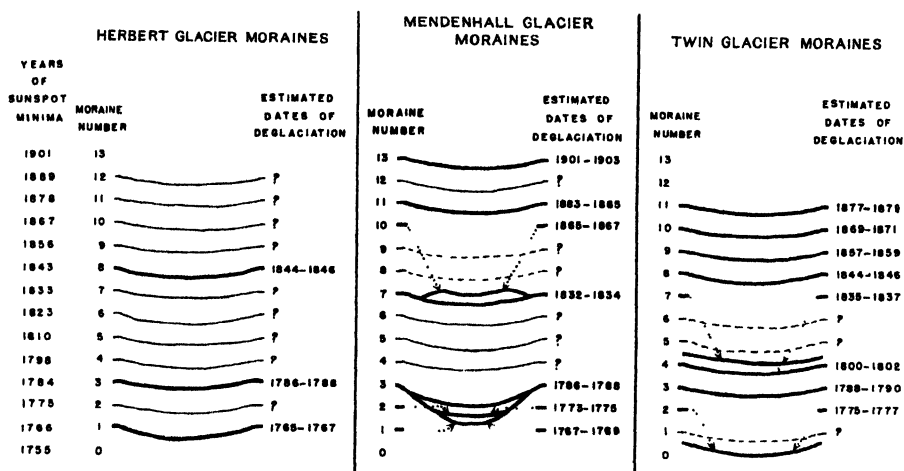


FIG. 18—Interpretation of periodicity in the formation of moraines of Herbert, Mendenhall, and Twin Glaciers, assuming a moraine to be formed at each sunspot minimum of the "11-year" cycle during a period of general glacier recession. Heavy lines are sampled moraines, light lines are visible but unsampled moraines, broken lines are moraines presumably buried or destroyed by a subsequent readvance. See text (on Herbert and Mendenhall Glaciers) for description of technique of estimating age of moraines.

produced there every year, and that the usual interval between heavy seed crops is three to four years; heavy crops occurred in 1945 and 1949, and a particularly light crop in 1948. Mr. Leo A. Isaac of the Pacific Northwest Forest Experiment Station states (personal communication) that the usual interval between heavy seed crops of Sitka spruce in coastal Oregon and Washington is about seven years, and that particularly heavy seed crops were noted there in 1929, 1933, 1937, and 1949, whereas in 1948 the crop was a failure. We may conclude, therefore, that although more seeds are available in some years than others, some seeds are available in most years, and the usual interval between heavy crops is much less than the interval suggested here between the formation of successive moraines.

PROPOSED FURTHER TESTS OF THE HYPOTHESIS

Now that the framework of the hypothesis has been presented and the evidence so far collected has been fitted into it, I should like to point out what kind of evidence is needed for testing it further.

First of all, we need to know for many glaciers of northwestern North America how greatly shrunken the glaciers were before the maximum recent advance, for how long a time they were in that shrunken condition before the advance began, when it began, its rate of advance, and when the peak occurred. Careful study of both the living forest trees and the interstadial fossil forest remains should supply this information. Work has already been carried on for many years by Cooper³⁸ for the Glacier Bay region, but more work is needed even there.

Secondly, we need to study in much more detail all the moraines available for a given glacier; those of Herbert seem most promising because of their apparent regularity and completeness.

Thirdly, there are several strong moraines that have been formed by various glaciers of this general region at known dates since 1900. The times at which these were formed should be compared with the years of sunspot minima shown in Figure 17 to see whether they fit into the scheme.

Fourthly, we need to compare distances of recession from position of maximum recent advance to present ice front for many north-facing and south-facing glaciers. Among glaciers with comparable nutrition and exposed to comparable amounts of clear and cloudy weather, the south-facing glaciers should have receded much greater distances than the north-facing ones, if differences in amount of solar energy impinging on the ice fields and their glaciers have been basically responsible for the variations we observe. Glaciers of symmetrical volcanic cones should be most useful for this test.

Finally, we need to study carefully through at least two cycles of sunspot minima and maxima the various elements of weather at a series of stations located at different altitudes in this region, so that the mechanics by which the glacier economy is altered by variation in solar activity may be learned.

THE PRINCE WILLIAM SOUND ENIGMA³⁹

As I have pointed out earlier in this report, the recent glacier history of the Prince William Sound region does not correspond with that of the region as a whole. Cooper⁴⁰ and other investigators have found that within

³⁸ W. S. Cooper: The Recent Ecological History of Glacier Bay, Alaska: I, The Interglacial Forests of Glacier Bay, *Ecology*, Vol. 4, 1923, pp. 93-128; *idem*: A Fourth Expedition to Glacier Bay, Alaska, *ibid.*, Vol. 20, 1939, pp. 130-155.

³⁹ Field (personal communication) points out that there are a few other enigmas, such as the Lituya Bay area on the west slope of the Fairweather Range where the two big glaciers have been advancing slowly for some decades and are now far in advance of their position in 1786.

⁴⁰ W. S. Cooper: Vegetation of the Prince William Sound Region, Alaska; With a Brief Excursion into Post-Pleistocene Climatic History, *Ecological Monographs*, Vol. 12, 1942, pp. 1-22.

the past 40 years some of the glacier termini here have advanced much farther than at any other time within at least 500 years. Field reports (personal communication based on information received from Douglas N. Brown) that advances are even now in progress. I have little explanation to offer at present except that this region has much higher annual snowfall at sea level than any other part of Alaska. It is reported that Whittier has a mean annual snowfall of 175 inches, and Valdez 266 inches.⁴¹ Fort Liscum, five miles southwest of Valdez, has 369 inches a year and has had as much as 691 inches in one season. The Prince William Sound region must therefore be also one of great cloudiness, which should screen out direct influences of variation in solar activity on glacier ablation rates. At Juneau the mean annual snowfall amounts to only 114 inches. Field (personal communication) states also that the névé line in Prince William Sound, at least in the north-western part, at Harriman Glacier and in Blackstone Bay, is much lower than at most other places along the coast. In this connection it is important to point out that with increase in temperature, which has been noted since 1900 especially, the altitude at which maximum precipitation occurs in the form of snow should rise.⁴² Simple computations show that it should rise about 280 feet per degree Fahrenheit rise in temperature. If the zone of maximum precipitation in the form of snow was already at a very low altitude in the early 1600's, as it seems to be today, perhaps the reduction of temperature which apparently occurred in the late seventeenth and early eighteenth centuries would not have had much effect. It should also be true that for ice fields nourished rather uniformly over a wide altitude range because of the precipitousness of the surfaces of accumulation, as seems to be the case in the Prince William Sound region, increase in temperature of even several degrees over a period of years should make little difference in the amount of snow that reaches the glaciers; though the altitude of maximum precipitation as snow would rise, nourishment should still be about the same. Consideration of these ideas would lead us to expect local reduced sensitivity of the Prince William Sound glaciers to changes in solar activity.

The greatest sensitivity to solar changes should be shown by glaciers nourished by ice fields lying mainly at a critical low altitude without numerous high peaks to draw from, such as the Juneau Ice Field, where, as has been noted, the firn line now lies just a few hundred feet below the general level of its snow accumulation surface. A general rise in temperature of

⁴¹ "Climate and Weather of Alaska" prepared by Weather Central, 7th Weather Group, Ft. Richardson, Alaska, U. S. Army, 1947. (Mimeographed.)

⁴² W. O. Field, Jr.: Glacier Recession in Muir Inlet, Glacier Bay, Alaska, *Geogr. Rev.*, Vol. 37, 1947, pp. 369-399; reference on p. 397.

only a few degrees would expectably cut off the whole ice field from much of its source of snow and perhaps replace it with an equivalent amount of rain, which would cause ablation rather than accumulation and result in rapid shrinkage. It is quite possible that the extensive recession in Glacier Bay, where the accumulation surfaces lie at altitudes much lower than those of the Juneau Ice Field, has been brought about by this mechanism, emphasized of course by the palmate valley system noted by Cooper.⁴³

To summarize, the glaciers emanating from the southern part of the Juneau Ice Field, including Eagle, Herbert, Mendenhall, Norris, Taku and its tributary arm, Hole-in-the-Wall, and Twin Glaciers, seem to have advanced in unison to a maximum sometime in the early or middle eighteenth century, which surely had not been exceeded since before the 1300's, and from which recessions of 1.3 miles to 5 miles beginning by 1765 at the latest subsequently occurred. The same chronology has been reported from Glacier Bay, Alaska, from Garibaldi Park, British Columbia, from Mt. Hood, Oregon, and even from Norway and Iceland. A close correlation is noted between the time of this glacier maximum and the end of the 70-year period of great sunspot dearth which extended from 1645 to 1715. The few spots observed then were all in the sun's southern hemisphere, but whether this fact has any bearing on the case is not known. The dearth period was independently reported by Maunder from historical records and Douglass from living pine-tree growth curves in Arizona. The hypothesis is offered that reduction of solar energy inflow to the earth and the various weather alterations attendant upon that great and prolonged sunspot dearth resulted in the general glacier advance that had its climax in the middle eighteenth century. The relatively high positive correlation that exists between winter atmospheric pressure and sunspot number in the latitude and longitude represented by the northwestern part of North America, as reported by Clayton, is offered as one evidence that glacier advance at times of low sunspot numbers is to be expected here. Further evidence is the relation between times when recessional moraines have been formed since the middle eighteenth century by Herbert, Mendenhall, and Twin Glaciers and the years when sunspot minima of the "11-year cycle" occurred. The need for further detailed information for testing this hypothesis is emphasized. The trend since 1765 has been one of general recession except for occasional slight temporary readvances such as observed in the Norris in the 1880's and from 1906 to 1916. For the past third of a century almost all of the glaciers emanating

⁴³ Cooper, *The Problem of Glacier Bay, Alaska* (see footnote 3, above).

from the southern half of the Juneau Ice Field have receded at an accelerated rate. The Taku and Hole-in-the-Wall Glacier system constitutes the one notable exception. Its strong advance, continuing from about 1900 to the present, is still in need of adequate explanation.

If further work confirms the relation suggested here between reduced solar activity and glacier advance, we may have new evidence for testing old theories regarding the causes of Pleistocene glaciation. In closing I should like to quote from a recent article by Donald H. Menzel⁴⁴ that is particularly apropos.

We are now in a scientific period where intensive study of the sun, together with simultaneous study of many types of terrestrial phenomena, should lead to discoveries of vital interest and practical value. . . .

Geologists and meteorologists have hesitated to ascribe the variability of terrestrial climate to a solar cause. But many have gradually come to the conclusion that a solar origin is the only remaining acceptable hypothesis. A million years is only a small amount of time in terms of the age of the sun or earth. Any variations in the output of solar heat cannot be attributed to evolution. But we cannot disprove, at the present time, the suggestion that the sun may have a long-range variability in addition to its 11-year cycle.

⁴⁴ D. H. Menzel: The Sun and the Earth, *Science*, Vol. 108, 1948, pp. 590-591.

CLIMATIC TYPES AND THE VARIATION OF MOISTURE REGIONS IN TURKEY

SIRRI ERİNÇ

OF FUNDAMENTAL importance for the development of agriculture in Turkey is a better understanding of its climate. With that end in view the author recently classified the climates of Turkey according to Thornthwaite's original system.¹ In the present paper he applies Thornthwaite's new classification,² with special reference to the variability of moisture regions. Comparison with the earlier system and with other classifications shows that the new system reflects the true conditions more accurately. It deserves much attention in Turkey because it makes possible the determination of the limits of droughts, and of their severity and probable frequency, and provides the means for calculating water deficiency.

MOISTURE REGIONS

According to Thornthwaite's moisture index, almost two-thirds of Turkey lies within the zero isarithm (Fig. 2), which is considered the limit between generally dry and generally moist climates. The whole interior of Anatolia, the southern part of the Aegean region, by far the greater part of Thrace, the plain of Adana (Çukurova), and the southeastern Anatolian plateaus lie within this isarithm. The dry climates of the interior, the most compact dry region of the country, extend eastward, following the chief trends of the relief, to include the basin of Lake Van. In the west they reach the Aegean coast, where the mountain ranges, interrupted by deep depressions, are parallel to the chief rain-bearing winds. In the south they extend to the Mediterranean through the deep valley of the Göksu and the limestone plateau of the middle Taurus. Dry climates do not, however, reach the Black Sea; they approach it only between Samsun and Sinop, where the relief is low.

Moist climates are confined principally to the northern and southern mountain ranges, but there are also extensive moist subhumid areas on the

¹ Sirri Erinç: The Climates of Turkey According to Thornthwaite's Classifications, *Annals Assn. of Amer. Geogr.*, Vol. 39, 1949, pp. 26-46.

² C. W. Thornthwaite: An Approach toward a Rational Classification of Climate, *Geogr. Rev.*, Vol. 38, 1948, pp. 55-94.

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high plateaus of northeastern Anatolia, where the summer is rainy and less warm. Truly humid climates occur chiefly in belts along the Black Sea coast between Samsun and the Turko-Russian frontier and in the vicinity of Zonguldak and on the Mediterranean around the Gulf of Antalya. There is, however, a marked difference between these northern and southern humid regions. Perhumid and fourth and third humid climates at sea level are confined to the north; a large summer water deficiency is characteristic of the south. Small isolated humid areas are found in high altitudes.

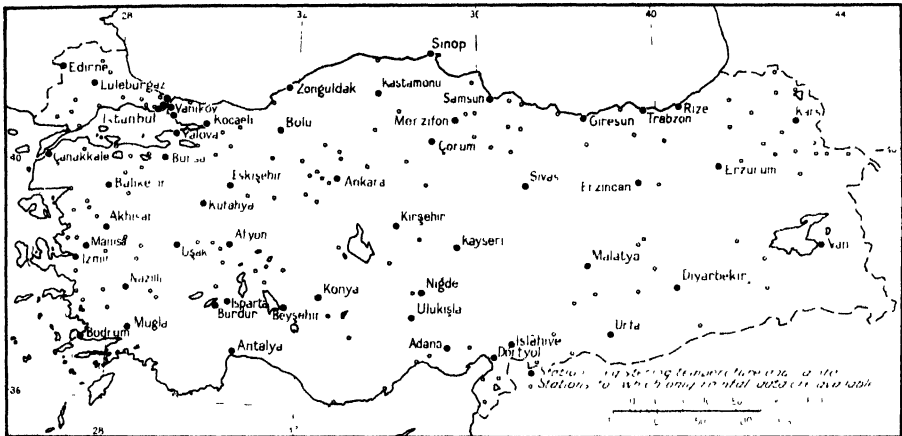


FIG. 1.—Location of climatic stations.

These moisture regions as determined by Thornthwaite's new system (Fig. 2) do not coincide with those of his old system, though there is a general resemblance. Semiarid conditions are encroaching on the old C climates in central Anatolia, Thrace, and Çukurova. Certain stations classified as humid according to the old system are now designated "moist subhumid." In general, the new method reflects regional differences better, as a consideration of Table I will make clear.

The results obtained by the use of Köppen's formula are far from the reality, as the present author pointed out in his earlier paper.³ Moisture regions of Turkey according to De Martonne's classification⁴ (Fig. 3) show some resemblance to those of the present map (Fig. 2), but there are important differences. The aridity index of 20, regarded by De Martonne as the limit of the dry climates, encircles a smaller area in interior Anatolia and excludes the southern part of the Aegean region and the dry interior of

³ Ering, *op. cit.*, p. 27.

⁴ Ali Tanoğlu: Indices d'aridité de la Turquie, *Türk Coğrafya Dergisi* (Turkish Geogr. Journ.), No. 1 1943, pp. 39-41.

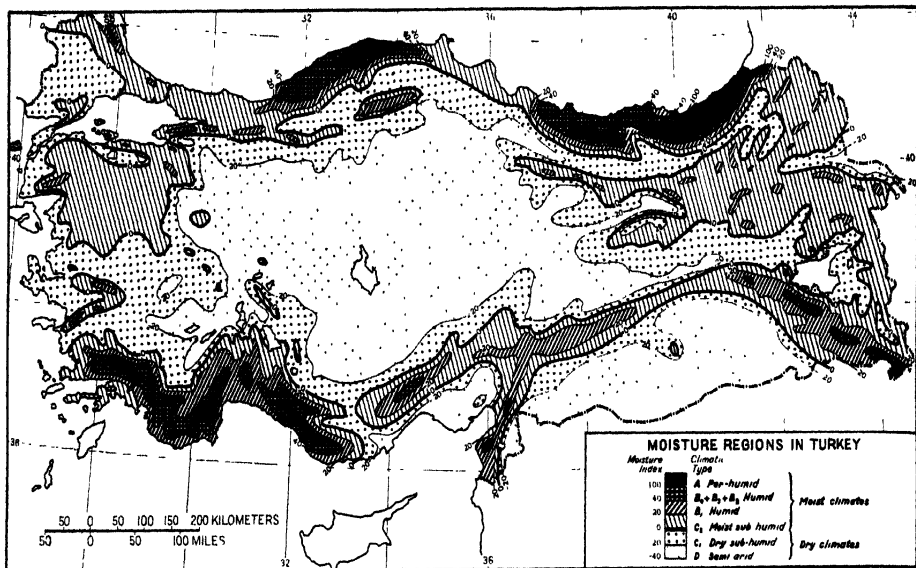


FIG. 2—Moisture regions according to Thornthwaite's new classification.

TABLE I

STATION	MEAN ANNUAL		OLD P-E INDEX	NEW MOISTURE INDEX	DESIGNATION	
	TEMPERATURE (°C.)	PRECIPITATION (cm.)			OLD	NEW
Dörtöyl	19.7	108.1	75.0	18.7	B	C ₁
Zonguldak	12.9	119.4	103.5	74.4	B	B ₁
Nazilli	17.2	68.7	55.0	-4.9	C	C ₁
Vaniköy	13.8	69.6	58.3	9.3	C	C ₁

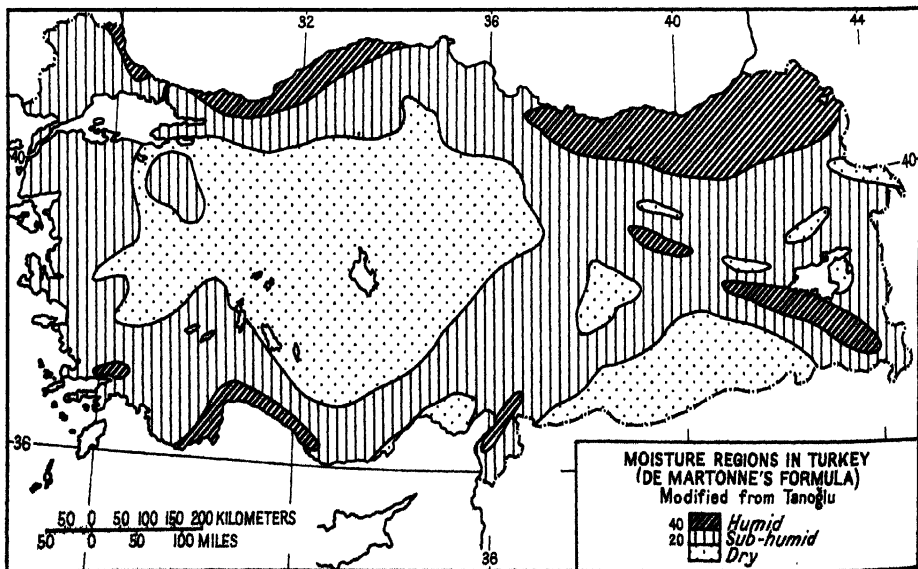


FIG. 3—Moisture regions according to De Martonne's classification.

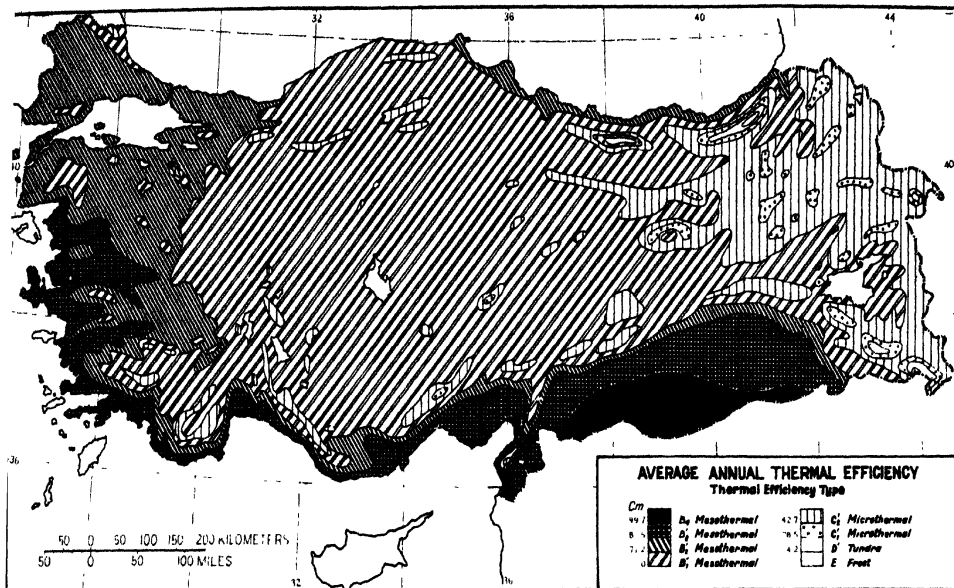


Fig. 4—Thermal efficiency and the distribution of potential evapotranspiration.

TABLE II

STATION	MEAN ANNUAL TEMP. (°C.)	PRECIP. (cm.)	PRECIPITATION REGIME	AFTER KÖPPEN	AFTER DE MARTONNE	AFTER THORNTHWAITTE	NATURAL VEGETATION
Kars	4.6	50.0	summer maximum	50.0 > 2(4.6+7) (moist)	34.2 (subhumid)	4.8 (moist subhumid)	steppe
Yalova	14.2	74.9	winter maximum	74.9 > 2(14.2+7) (moist)	30.9 (subhumid)	10.7 (moist subhumid)	forest
Antalya	18.5	105.1	winter maximum	105.1 > 2(18.5+7) (moist)	36.8 (subhumid)	31.4 (first humid)	forest
Bursa	14.3	70.1	winter maximum	70.1 > 2(14.3+7) (moist)	28.8 (subhumid)	4.9 (moist subhumid)	forest-steppe border
Lüle- burgaz	12.9	56.2	winter maximum	56.2 > 2(12.9+7) (moist)	24.5 (subhumid)	-7.6 (dry subhumid)	steppe

Thrace. On the other hand, the moisture indices of the northeastern plateaus are exaggerated. According to De Martonne's formula the moisture index of Kars (34.2), in a natural steppe region, is greater than that of Yalova (30.9), in a forest region. Such anomalies seem to result from insufficient consideration of rainfall and temperature regimes and of soil-moisture utilization. A comparison of the three systems of classification (Table II) indicates the refinement obtained by the use of Thornthwaite's recent formula.

POTENTIAL EVAPOTRANSPIRATION

Figure 4, a map of thermal efficiency in Turkey, also shows the distribution of mean annual potential evapotranspiration. The average annual water need reaches its maximum in the southeastern part of the country, where it

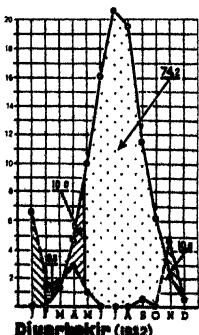
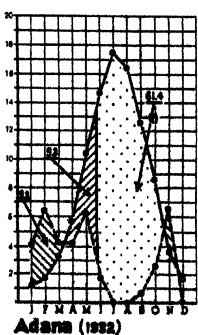
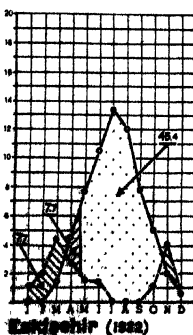
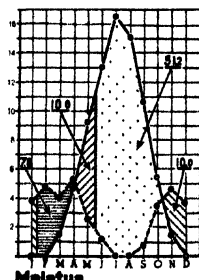
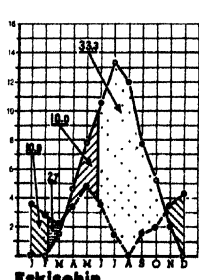
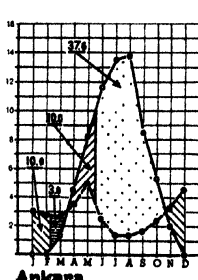
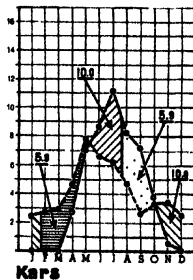
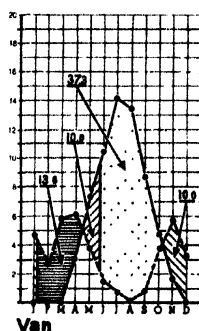
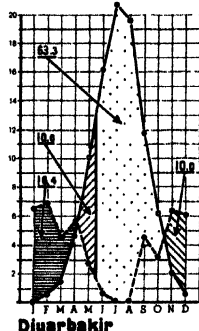
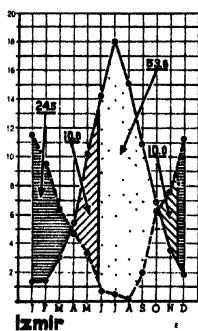
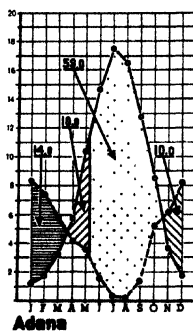
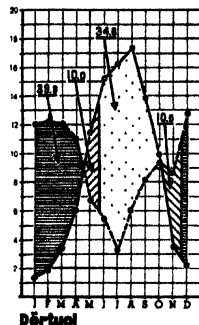
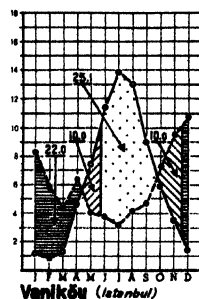
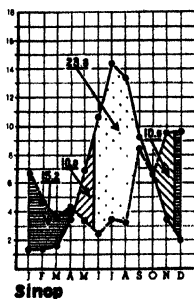
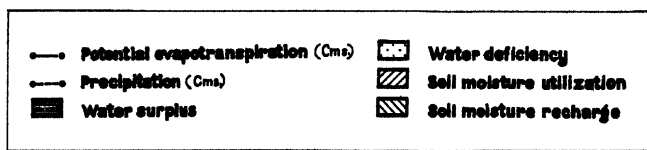
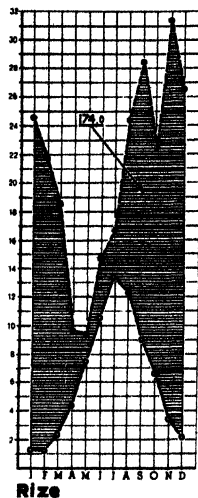


FIG. 5—The annual march of potential evapotranspiration as indicated by examples from fifteen climatic stations. (See Fig. 1 for location of stations.)

is more than 100 centimeters. In general, it decreases from the Mediterranean coast northward, and from the Aegean coast eastward to the high central and eastern plateaus. The average annual potential evapotranspiration is between 90 and 95 centimeters in the Mediterranean region and between 75 and 78 centimeters in the region around the Sea of Marmora, in Thrace, and in a strip along the eastern Black Sea coast. It is below 70 centimeters in interior Anatolia and between 45 and 55 centimeters in the northeastern highlands.

Typical examples of the annual march of potential evapotranspiration in Turkey are given in Figure 5. Water need during the winter is negligible, even in the warmest parts of the country; on the Mediterranean coast, for instance, it is less than two centimeters a month. Maximum water need generally occurs in July or August. In these months it is more than 20 centimeters in the southeast, about 17 or 18 centimeters on the south and west coasts, and between 11 and 14 centimeters in other regions.

SEASONAL VARIATION OF EFFECTIVE MOISTURE

Types of seasonal variation of effective moisture are shown in Figure 6. Although in the northeastern highlands precipitation is at the minimum in winter, the winter-dry, w and w_2 , types do not occur in Turkey. The r climates, with little or no water deficiency in any season, cover a small area in the northeastern highlands and strips along the east and west Black Sea coast. The interior of the country is occupied by the d type, with little or no water surplus in any season. In western and southern Asia Minor and in a small area in the east around Lake Van summer water deficiency and winter water surplus are both large (s_2), whereas in a northern belt and in most of the east they become moderate (s). In the southeast summer water deficiency reaches its maximum, more than 70 centimeters; the winter surplus here is moderate.

The new system expresses the influence of the rainfall regime on the water balance much better than the old one did. For example, localities such as Dörtyol, Kocaeli, Edirne, and Samsun, which have a more or less marked dry season, are given the more suitable designation s or s_2 . In the earlier classification they were type r .

SUMMER CONCENTRATION OF THERMAL EFFICIENCY

Figure 7 gives the distribution of summer concentration of thermal efficiency. Type a' occurs only in the corner of the Gulf of Iskenderon (Alexandretta), where summer concentration is 47.5 per cent. All the coastal sta-

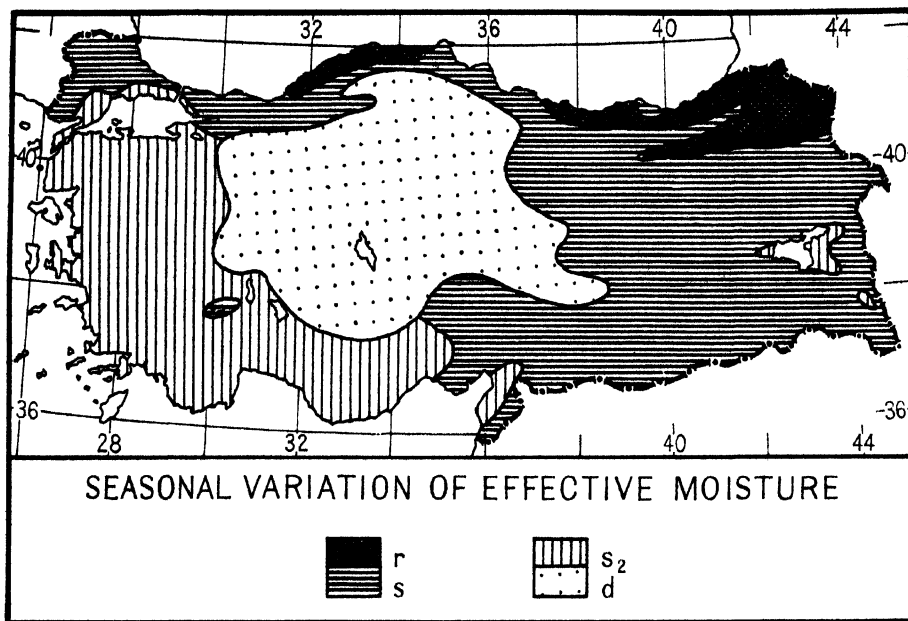


FIG. 6

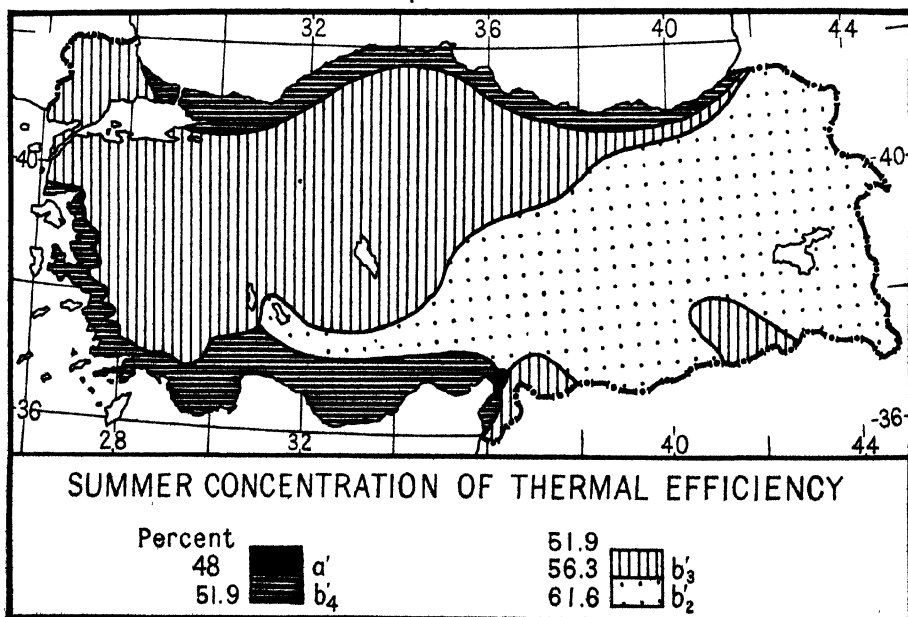


FIG. 7

tions in the north, south, and west fall in type b'_4 . By far the greater part of Asia Minor and Thrace belongs to type b'_3 , whereas the eastern and southeastern parts of the country show b'_2 conditions. The displacement of the zones of summer concentration of thermal efficiency from those of annual thermal efficiency (Fig. 4) gives an indication of the marine influences.

VARIABILITY OF THE MOISTURE REGIONS

The moisture regions shown in Figure 2 are obtained from average data. In reality, moisture indices and moisture regions in Turkey vary widely from year to year. The moisture index depends on the relation between precipitation and water need. Water need in turn is principally a function of temperature. In Turkey the mean temperatures of the same month in successive years do not show differences exceeding $\pm 0.7^\circ\text{--}0.8^\circ\text{C}$. from April to December. From December to April the differences are larger, $\pm 1.5^\circ\text{--}2.5^\circ$. But this winter period is short, and the negative variations, which occur more frequently, do not sensibly change the monthly values of water need, which are often very small. Even the less frequent positive variations do not cause great changes from one year to another in the amount of water need, for according to the formula the correction factor of insolation in this period is small.

In contrast, great changes occur in the amount and distribution of rainfall. Thus the displacements of moisture regions are determined chiefly by variations in the rainfall, both in time and in place. Such displacements affect the agricultural regions of the country and strongly influence crop yields. Severe droughts, of which there have been many in the agricultural history of Turkey, may cause crop failures. An analysis of these variations is therefore of great importance, for 85 per cent of the population of Turkey are engaged in agriculture and the population density is almost 200 to a square kilometer of cultivated land.⁵

A comparison of the yearly values of moisture, total wheat production, and average yields in certain selected provinces (Table III) demonstrates the influence of moisture-region displacements on agriculture. It is possible that the variations follow a certain periodicity. Scientific proof is, however, still impossible because the period of meteorological observations is short and historical information is incomplete. Moreover, we prefer in this paper to

⁵ Turkey has a low population density, about 23 to a square kilometer. "Agricultural" density, however, is about 12 times higher than in the United States (Turkey, 200 to a square kilometer of cultivated land; United States, 17) because the cultivated area is very small in Turkey. See also A. Tanoğlu: La densité de la population agricole en Turquie, *Türk Coğrafya Dergisi*, Nos. 7-8, 1945, pp. 117-118; and B. Darkot: Memleketimizin bazı ziraat problemleri, *ibid.*, Nos. 3-4, 1943, p. 280.

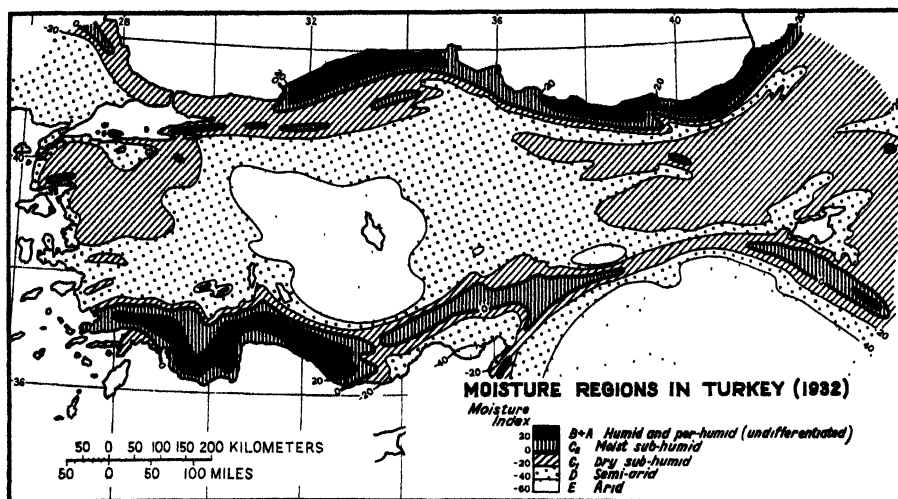


FIG. 8—Moisture regions in 1932, an unusually dry year

TABLE III

Cultivated area under wheat in thousands of hectares; production in thousands of quintals

PROVINCE	YEAR	PRECIPITATION (cm.)	MOISTURE INDEX	CULTIVATED AREA, *	PRODUCTION*	AVERAGE YIELD
Konya (Interior)	Mean annual	30.3	-32.6	175	1170	6.7
	1928	15.3		227	540	2.4
	1931	41.9		152	2390	15.7
	1932	14.3	-47.5	127	630	5.0
	1936	25.7		308	3410	11.1
Eskişehir (Interior)	Mean annual	30.7	-26.4	65	552	8.4
	1928	28.7		47	68	1.4
	1931	38.1		83	1005	12.1
	1932	19.3	-41.6	64	250	3.8
	1936	40.9		162	1329	8.3
Diyarbakır (Southeast)	Mean annual	47.2	-23.1	53	228	4.3
	1928	29.4		41	121	2.9
	1931	40.0		62	436	7.0
	1932	20.6	-46.7	92	318	3.4
	1936	43.5		77	723	9.3
Edirne (Thrace)	Mean annual	58.9	-6.2	11	127	11.0
	1928	35.9		10	149	14.9
	1931	78.5		11	243	22.0
	1932	31.1	-34.6	9	92	10.1
	1936	73.3		56	810	14.4

*Data from the Agricultural Statistics of the State.

stay away from speculation and be satisfied with the description of observations relative to the distribution of the variations, their range and intensity, and the trends in various regions that may be obtained from an analysis of the meteorological records. In Figure 8 the moisture regions of 1932 are shown. In that year, a very dry one, moisture indices were generally less

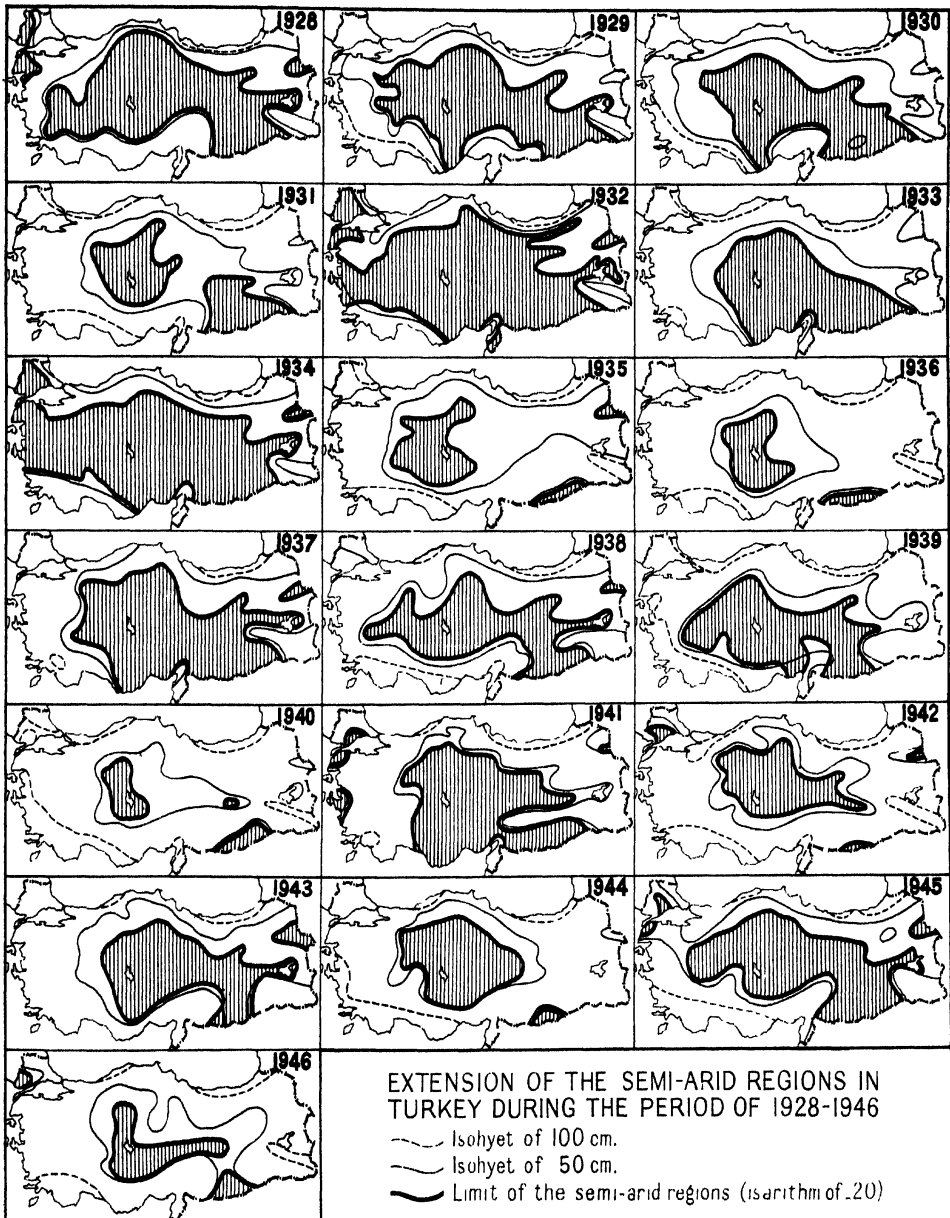


FIG. 9.—The semiarid areas are subject to large annual displacements, the most important variations occurring within the dry subhumid and moist subhumid areas. It will be noted that there are two regions of chronic drought, one in the interior, the other in the southeast, and these are often connected. During their largest extension semiarid areas may occupy more than three-fourths of the country. The trend of expansion is approximately east-west, following the general trend of the relief. Semiarid areas never reach the Black Sea, but in some years they extend to the west coast and, more often, to the middle and eastern Mediterranean shores. The northeastern highlands, with low temperatures and summer precipitation, the Black Sea coast, and southwestern Asia Minor, where the precipitation is heavy, have moist climates, even in the dry periods.

than average in all parts of the country. All of interior Anatolia was occupied by truly arid climates, and dry climates, limited by the zero isarithm, extended from the west coast to the eastern frontier; dry subhumid areas included western Asia Minor and most of Thrace. The northeastern highlands and northwestern Anatolia remained outside the dry area. The C_2 and B climates were largely confined to some parts of the Black Sea coast and to the western Mediterranean area. Graphs showing the water balance at three selected stations in 1932 are given in Figure 5.

Figure 9 shows the areal and quantitative changes in the rainfall and the distribution of semiarid conditions in Turkey 1928-1946. The 100-centimeter isohyet may be regarded as approximately the limit of the humid areas. The boundaries of the semiarid areas were estimated, except those of 1932, for which special computations were made.

APPENDIX I—CLASSIFICATION OF METEOROLOGICAL STATIONS

Station	Water need (cm.)	Summer need (%)	Precipi- tation (cm.)	Water surplus (cm.)	Water deficiency (cm.)	Surplus % of need	Def. % of need	Moisture index	Climatic type
Adana	97.8	50.0	53.4	14.0	59.0	14.3	60.3	-21.8	DB ₃ sb ₄
Afyon	69.0	55.0	41.8	4.6	32.3	6.6	46.8	-21.4	DB ₁ db ₃
Akhisar	87.0	54.7	60.0	26.1	53.4	30.0	61.3	6.7	C ₂ B ₃ s ₂ b ₃
Ankara	68.6	55.0	34.5	3.0	37.6	4.3	55.3	-28.8	DB ₁ db ₃
Antalya	97.6	50.2	105.1	66.2	59.3	67.8	60.7	31.4	B ₁ B ₃ s ₂ b ₄
Balikesir	77.8	53.5	66.1	25.8	34.3	33.1	44.0	6.7	C ₂ B ₃ s ₂ b ₃
Beyşehir	68.5	56.6	50.9	17.2	36.2	25.1	52.8	6.5	C ₂ B ₁ s ₂ b ₂
Bodrum	97.6	51.5	87.1	51.5	62.7	52.7	64.2	14.2	C ₂ B ₃ s ₂ b ₄
Bolu	63.0	52.6	52.3	10.3	21.6	16.3	34.2	-4.2	C ₁ B ₁ sb ₃
Burdur	73.4	54.4	40.7	8.3	41.5	11.3	56.5	-22.6	DB ₂ sb ₃
Bursa	76.9	52.6	70.1	20.5	27.9	26.6	36.2	4.9	C ₂ B ₃ s ₂ b ₃
Çanakkale	80.6	52.2	65.4	22.2	43.5	27.5	53.9	-4.8	C ₁ B ₂ s ₂ b ₃
Çorum	66.3	55.5	37.0	2.1	31.8	3.1	50.9	-27.4	DB ₁ db ₃
Diyarbakir	93.5	60.3	47.2	16.4	63.3	17.5	67.7	-23.1	DB ₃ sb ₃
Dörtöyl	102.5	47.5	108.1	39.9	34.8	38.9	33.9	18.7	C ₂ B ₄ s ₂ a
Edirne	75.3	55.1	58.9	13.7	30.5	18.1	40.5	-6.2	C ₁ B ₃ sb ₃
Erzincan	69.1	57.7	38.1	7.6	39.0	10.9	56.4	-22.9	DB ₁ sb ₂
Erzurum	55.0	60.1	50.0	12.2	17.6	22.1	32.0	2.9	C ₂ C ₃ sb ₂
Eskişehir	65.4	54.8	30.7	2.7	33.3	4.1	50.9	-26.4	DB ₁ db ₃
Giresun	75.8	50.6	140.2	63.3	0.2	83.5	0.2	82.3	B ₄ B ₂ rb ₄
İzmir	92.7	51.1	63.9	24.5	53.6	26.4	57.8	-8.2	C ₁ B ₃ s ₂ b ₄
İslâhiye	89.3	55.5	90.2	47.3	56.9	52.9	63.7	14.7	C ₂ B ₃ s ₂ b ₃
Isparta	69.6	56.0	57.2	20.6	33.5	29.4	48.1	0.6	C ₂ B ₁ s ₂ b ₃
Kars	49.5	56.9	50.0	5.9	5.9	11.9	11.9	4.8	C ₂ C ₃ rb ₂
Kastamonu	63.0	54.4	36.5	1.3	17.6	2.0	27.9	-14.7	C ₁ B ₁ db ₃
Kayseri	68.6	56.8	37.9	6.2	37.4	9.0	54.4	-23.7	DB ₁ db ₂
Kirşehir	69.2	55.2	32.7	6.1	40.6	8.8	58.6	-26.3	DB ₁ db ₃
Kocaeli	76.6	50.3	81.3	20.4	16.3	26.6	21.2	13.3	C ₂ B ₃ sb ₄

APPENDIX I—CLASSIFICATION OF METEOROLOGICAL STATIONS (*continued*)

Station	Water need (cm.)	Summer need (%)	Precipi- tation (cm.)	Water surplus (cm.)	Water deficiency (cm.)	Surplus % of need	Def. % of need	Moisture index	Climatic type
Konya	67.8	53.5	30.3	1.5	39.4	2.2	58.1	-32.6	DB ₁ db ₃
Kütahya	63.9	53.0	51.4	13.4	26.4	20.9	41.3	-3.8	C ₁ B ₁ s ₂ b ₃
Lüleburgaz	74.1	54.7	56.2	13.7	32.2	18.4	43.4	-7.6	C ₁ B ₂ sb ₃
Malatya	78.0	57.3	35.0	7.8	51.2	10.0	65.6	-29.3	DB ₂ db ₂
Manisa	88.3	53.6	66.1	26.5	49.2	30.0	55.7	-3.4	C ₁ B ₃ s ₂ b ₃
Merzifon	67.8	52.6	37.1	0.1	32.5	0.1	47.9	-28.6	DB ₁ db ₃
Mugla	80.5	54.1	144.3	106.0	36.8	131.6	45.7	104.2	AB ₂ s ₂ b ₃
Nazilli	93.5	52.1	68.7	29.4	56.7	31.4	60.6	-4.9	C ₁ B ₃ s ₂ b ₃
Niğde	68.2	56.4	40.0	7.6	36.4	11.1	53.3	-20.8	DB ₁ sb ₂
Rize	74.7	48.5	249.3	174.0	0	232.9	0	232.9	AB ₂ rb ₄
Samsun	74.3	49.6	69.1	16.8	22.8	22.6	30.6	4.3	C ₂ B ₂ sb ₄
Sinop	74.8	51.4	66.8	15.2	23.8	20.3	31.8	1.3	C ₂ B ₂ sb ₄
Sivas	59.3	55.8	43.2	10.9	27.4	18.3	46.2	-9.4	C ₁ B ₁ sb ₃
Trabzon	76.1	49.8	87.9	28.6	17.2	37.5	22.6	24.0	B ₁ B ₂ sb ₄
Ulukışla	60.9	58.9	41.5	12.9	33.1	21.0	54.3	-11.5	C ₁ B ₁ s ₂ b ₂
Urfa	102.4	58.0	42.8	19.7	79.7	19.2	77.8	-27.4	DB ₄ sb ₂
Uşak	68.9	56.6	54.3	18.3	33.5	26.5	48.6	-2.6	C ₁ B ₁ s ₂ b ₂
Van	63.4	59.7	40.1	13.6	37.3	21.4	58.8	-13.8	C ₁ B ₁ s ₂ b ₂
Vanikoy	75.0	51.0	69.6	22.0	25.1	29.3	33.4	9.3	C ₂ B ₂ s ₂ b ₄
Yalova	75.9	50.7	74.9	22.8	24.5	30.0	32.2	10.7	C ₂ B ₂ sb ₄
Zonguldak	70.6	50.7	119.4	58.7	10.3	83.1	14.5	74.4	B ₃ B ₁ rb ₄

ECOLOGICAL OBSERVATIONS ON THE GREAT KHINGAN EXPEDITION*

KINJI IMANISHI

THE northwestern corner of Manchuria, occupied by the vast and complicated mountain system of the northern Great Khingan, has been visited by few scientific travelers. The Russian anthropologist S. M. Shirokogoroff crossed it from west to east in 1915.¹ Miss E. J. Lindgren, English anthropologist, visited the lower part of the Bistraya in 1929,² and the German geographer Bruno Plaetschke explored its upper part in 1932.³ A Japanese geologist, S. Yamashima, also entered the Bistraya in 1934.⁴ In 1942, the present writer organized an expedition to traverse the region from Hailar to Moho, a town on the right bank of the Amur River.

GENERAL ROUTE OF THE EXPEDITION

The region is a gently undulating plateau rising 200 or 300 meters above the valley floors to a general elevation of about 1000 meters. It is almost entirely forest-clad, except on the valley floors (Fig. 4) and the *golets*, solitary peaks above the timber line. We ascended the 1500-meter Okoldoi, the highest peak in the drainage basin of the Bistraya. The valley floors are flat, sometimes four kilometers or more in width in the lower parts of the main rivers. Here are meadows and reed swamps, but in the upper stretches tussock swamp, shrub swamp, and bog-moss swamp make travel difficult. The water-holding capacity of the soils is poor, because of the wide occurrence of permanently frozen ground, with which is also associated sudden flooding of the rivers when it rains.

Climatologically this region belongs to the winter-dry, summer-rainy

*The writer wishes to express his gratitude for the privilege of freely using data from unpublished manuscripts by the members of the expedition: Mr. K. Huzita (geologist), Mr. T. Kira (botanist), Mr. T. Umesao (zoologist), Mr. Y. Ban† (geographer), and Mr. Z. Kawakita (geographer). Heartfelt thanks are also tendered to Mr. E. M. Harwood, who has read and corrected this paper and given much valuable advice.

¹ S. M. Shirokogoroff: *Social Organization of the Northern Tungus*, Shanghai, 1933.

² E. J. Lindgren: *North-western Manchuria and the Reindeer-Tungus*, *Geogr. Journ.*, Vol. 75, 1930, pp. 518-536.

³ Bruno Plaetschke: *Das Bergland der nordwestlichen Mandschurei*, *Petermanns Mitt. Ergänzungsheft No. 232*, 1937.

⁴ S. Yamashima: *Geology of Northern Great Hsing-an Mountains*, *Shina Kôgyô Zihô No. 83*, Dairen, 1935. (In Japanese.)

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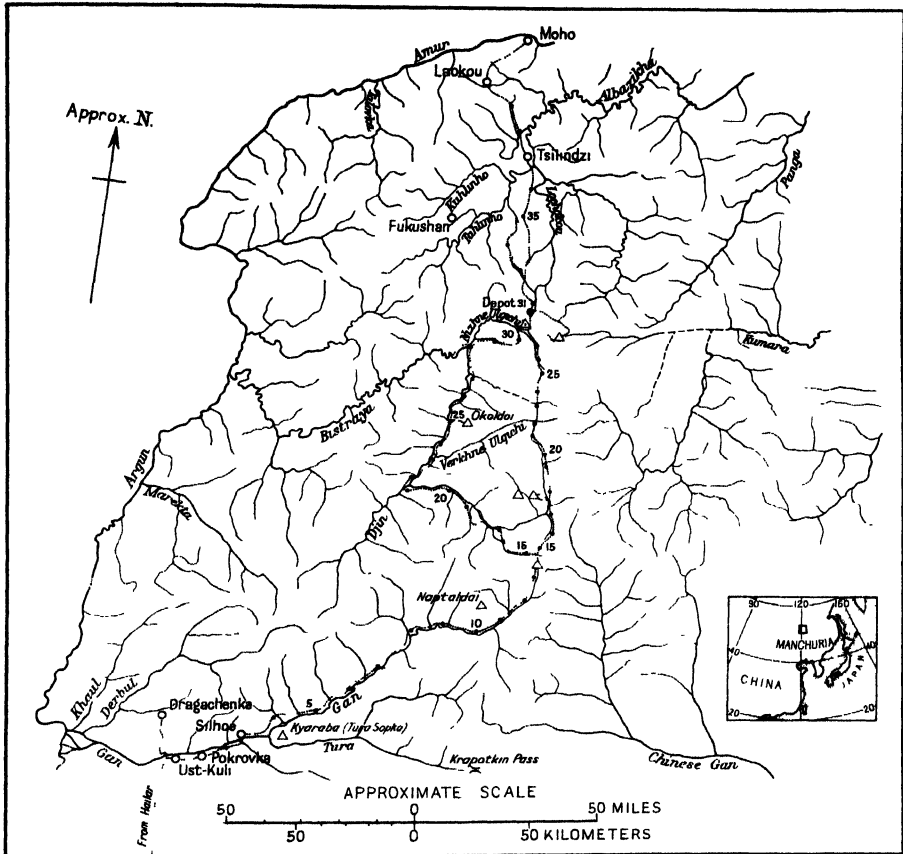


FIG. 1.—The Great Khingan region. The map is drawn from the author's compilation (1 : 800,000 and with drainage in detail) from vertical aerial photographs taken by the Manchurian Air Line Co. No astronomical observations were available to tie in the compilation but on recent maps the confluence of the Argun and Gan is about $119^{\circ} 20' E.$ and $50^{\circ} 20' N.$ The expedition's route is shown by a dotted line, camp sites by black dots.

type.⁵ There is little snow, though the native hunter uses a kind of ski for getting about in winter. In view of these seasonal conditions, we decided to travel after the snow and ice had melted and before the summer rain came. The expedition started from Hailar on May 12. From Dragachenka, a center of Russian colonization, we followed the main valley of the Gan, mostly on foot. On May 31 we reached the watershed between the Argun and Sungari river systems. For exploration of the Bistraya we divided into two parties, one going upstream, the other downstream.

⁵ See E. E. Ahnert: *Manchuria as a Region of Pioneer Settlement: Its Natural Conditions and Agricultural Possibilities*, in *Pioneer Settlement*, Amer. Geogr. Soc. Special Publ. No. 14, 1932, pp. 313-329; reference on p. 319. Three stations in the Great Khingan have 88 to 91 per cent of their rain from May to September inclusive.

Meanwhile, a supporting party started south from Moho on May 30, keeping in communication with the main body of the expedition by radio. On June 20 the upstream party met the supporting party at the appointed spot in the forest, and six days later we were united with the downstream party, at the confluence of the Nizhne Ulgichi. Here we replaced our pack horses and their Russian owners with reindeer and native attendants, for reindeer can travel much more easily over the swamp tussocks.

Along the Bistraya there was no continuous beaten track. Sometimes we followed the trails of native hunters for a short distance, but the Bistraya itself is their main highway (canoe). Eventually we found ourselves on the old surveying route to Moho, which we reached on July 16.

THE VEGETATION

The northern Great Khingan is mostly covered with forest of Dahurian larch (*Larix Gmelini*). This forest, characteristic of eastern Siberia, extends promontorywise into northwestern Manchuria. It seems to have been treated as a part of the homogeneous Siberian taiga on vegetation maps of the world.⁶ But ecologically the Siberian taiga may be divided into three parts. The eastern and western parts are distinguished by their evergreen coniferous forest, indicative of a more humid climate; it may be called the "wet taiga." Between is the deciduous coniferous forest of eastern Siberia, which may be called the "dry taiga." The boundary between the wet taiga and the dry taiga is demarcated by the 7.0 line of Kira's humidity index (index of precipitation effectiveness).⁷

Larches in this region are generally stunted; the average diameter is about 20 centimeters, rarely more than 30 centimeters. The ground cover is a carpetlike heath of low shrubs such as mountain cranberry (*Vaccinium vitis-idaea*) and wild rosemary (*Ledum palustre*). The cranberry is less than 10 centimeters in height and prefers sunny, dry slopes; wild rosemary grows on more humid soil and often reaches 30-40 centimeters. A locally tall, dense thicket of rhododendron (*Rhododendron dauricum*) occurs as an undergrowth of the mixed stand of larch and white birch (*Betula platyphylla*). Scotch pine

⁶ For instance, those by H. Brockmann-Jerosch (*Baumgrenze und Klimacharakter, Beiträge zur geobotanischen Landesaufnahme* 6, Pflanzengeographische Kommission der Schweizerischen Naturforschenden Gesellschaft, Zurich, 1919) and E. Rübel (*Pflanzengesellschaften der Erde*, Bern-Berlin, 1930). Also the map of "The Northern Temperate Zone in Asia," Figure 1 (on p. 28) in Martin Vahl and Johannes Humlum: *Vahl's Climatic Zones and Biochores, Acta Jutlandica: Aarsskrift for Aarhus Universitet*, XXI, 2 (N 6), Copenhagen, 1949.

⁷ Tatuo Kira: *Climates and Vegetation Types of the Western Pacific and Eastern Asia: A Proposed New System of Ecological Classification*. (Unpublished manuscript.)

(*Pinus sylvestris*), also found on the fixed sand dunes around Hailar, is sometimes mixed with larch; mostly this tree grows in small patches on the upper parts of steep southern slopes. On the west the larch forest of the Great Khingan passes into the Mongolian steppe. On the east, between the larch forest and the steppe of the Manchurian plain, there is a narrow belt of deciduous hardwood forest of *Quercus mongolica*.

On the expedition's route the Mongolian steppe touched the lower Gan, where the white birch made its appearance, in small groves on northern slopes; as we went northeastward, the groves became larger and expanded, first to the east of the hills and then to the west. Near the confluence of the Tura, the largest tributary of the Gan, larch appeared for the first time. This is the so-called "forest-steppe" zone, an ecotone between steppe and forest; its width in this region is about 40 kilometers.

The forest steppe is nothing but an extension of the forest so far as the white birch is concerned, for it was originally a tree of the taiga. And in fact the vegetation of the forest steppe contains only a few steppe derivatives. As most of the constituents of the dry steppelike vegetation in the valley floors are various kinds of tall herbs, it may be described as meadow. It appears also in the forest region, for instance at the confluence of large tributaries such as the Djin, the Verkhne Ulgichi, and the Nizhne Ulgichi along the Bistraya, but it is better developed in the lower part of the Gan, where we saw purple pasqueflowers (*Pulsatilla* spp.) in full bloom as forerunners of spring. Besides meadow, reed swamp of *Calamagrostis Langsdorfii* occupies a considerable area in the wide valley floors of the lower and middle reaches of the Gan as well as of the Albazikha.

As regards animal life, the forest-steppe zone may rather be considered an extension of the elm-savanna climax or biome of Manchuria and North China, as is indicated by the presence of the roe deer (*Capreolus pygargus*), whereas steppe is indicated by the presence of the Mongolian gazelle (*Gazella gutturosa*) and taiga by the presence of the moose (*Alces americana*).

In this region the so-called "gallery forest" is well developed. On the newly deposited soils along the streams good drainage and absence of a frozen subsoil favor tree growth. The gallery forest includes poplar (*Populus suaveolens*) and willow (*Salix* spp. and *Chosenia macrolepis*). Undergrowth consists of Siberian bird cherry (*Prunus padus*), alder (*Alnus sibirica*), hawthorn (*Crataegus sanguinea*), Tatarian dogwood (*Cornus alba*), and so on. This forest coincides closely with the meander belt. In the lower part of the large rivers it is often several hundred meters wide.

Upstream, elements of the forest-steppe zone gradually disappear.

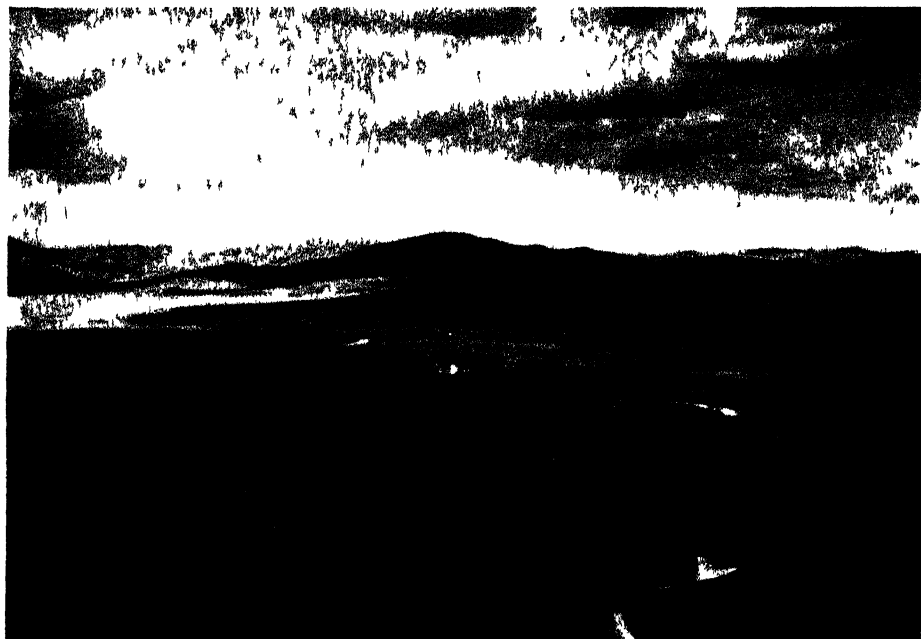


FIG 2—Valley of the lower Gan near its confluence with the Tura Note the gallery forest

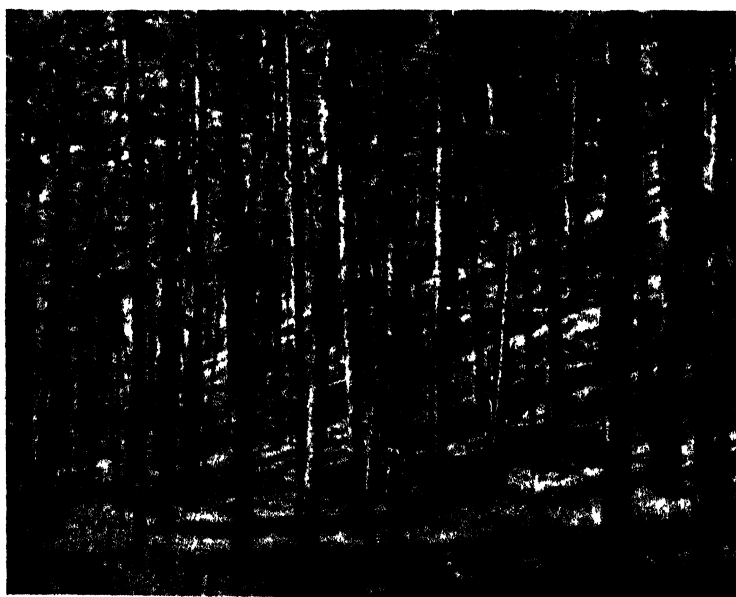


FIG 3—Characteristic larch forest



FIG. 4—View in the Gan Valley, showing contrast between forested slopes and treeless valley floor.

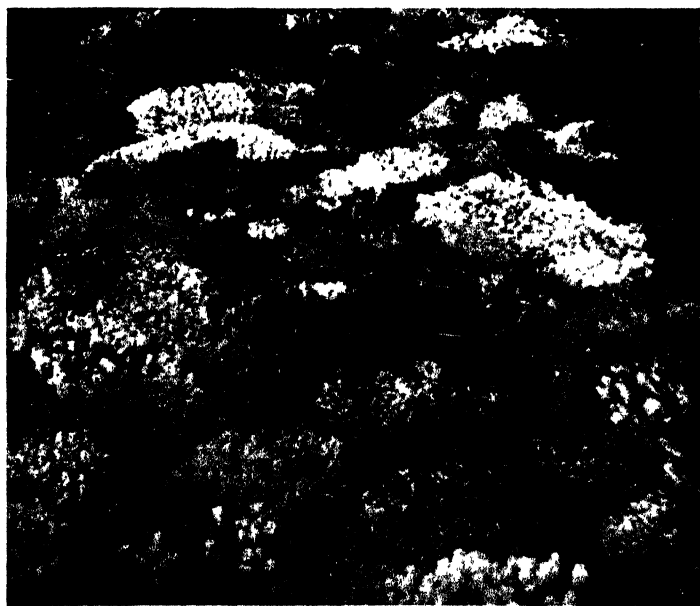


FIG. 5—Lichen mat of *Cladonia* and other species.

Meadow and reed swamp give way to sedge swamp, shrub swamp, and bog-moss swamp. The roe deer is replaced by the moose. The gallery forest changes in structure and decreases in width. Poplar drops out first; shrub willow remains to the last. Larch and birch sometimes grow together with willow, and in such places larch often replaces willow and finally forms gallery forest by itself.

The sedge swamp is composed of several species of sedge (*Carex*) and cotton grass (*Eriophorum vaginatum*). The old roots of these plants form tussocks; their diameters and the distances between them average about 25–30 centimeters. Throughout the upper Gan and the middle and upper reaches of the Bistraya and the Albazikha they cover the greater part of the valley floors. Two special dwarf birches (*Betula fruticosa* and *B. exilis*), 1 to 1.5 meters high, with small round leaves, often grow densely over the sedge-swamp tussocks. Seen from a height a valley floor covered with them has the appearance of a smooth green meadow. Such a landscape, characteristic of northern Siberia, is known there as *jernik*,⁸ or shrub tundra, a phase of the forest tundra. In eastern Siberia its distribution is limited to the north of the 35° line of Kira's warmth index (index of temperature effectiveness). It is found not only in the swamp but also in the dry open glades on the slopes or on the ridges.

Sphagnum, the bog moss, first appeared in the spaces between tussocks of the sedge swamp but gradually increased with altitude. In shrub tundra it conceals itself under the dwarf birches. Swamps consisting of bog moss alone, or moss tundras, are also found here and there in small valleys at the sources of the large rivers. Peat accumulation seems to be rather poor as compared with that in the wet taiga region.

THE PROBLEM OF PAST CLIMATE

In the upper parts of the Bistraya and the Albazikha are patches of barren ground—broken masses of rock, on which only whitish or purplish lichens grow. The largest of these patches was 100 meters square; most of them were smaller. It is one of the Siberian landscapes, the lichen tundra, in miniature, a fact suggestive of the climatic relation.

These patches of rock waste lie not only on the slopes but on the ridges and valley floors as well. On the slope the rocky surface meets the valley floor abruptly, without a talus. On the valley floor the masses of rocks occur indifferently nearer the foot of the slope or the swamp; hence it is believed that the stones were formed in place and not transported.

⁸ From Plaetschke, *op. cit.*, pp. 78–80.

Furthermore, the rock masses seem to be widely distributed under the plant cover. They were revealed in numerous borings and were exposed under the roots of fallen trees. The depth of the boulder mass is uncertain. The size of the individual boulders tends to be uniform in one place; the largest one we found was three meters in diameter, but usually they were smaller. The spaces between them were sometimes filled with icy water.



FIG. 6—Characteristic scene near the tree limit, isolated larches, dwarf pine thicket, and lichen-covered boulder bed.

Barren grounds were also observed above the timber line (Fig. 6). On the ascent of Okoldoi, for instance, we noticed that larch and birch became sparse and dwarf pine (*Pinus pumila*) began to form dense undergrowth, in many places more than four meters high, at about a thousand meters. Above the timber line, dwarf pine mingled with patches of lichen-covered boulders. If these boulders result from the severe climate of high altitudes, are the boulder beds so widely distributed over the region also the result of a severe climate, perhaps in the past?

It must be noted that we saw no glacial topography, not even a cirque, though Plaetschke reported a moraine from the Gan and a cirque farther south. What type of climate produced such a vast rock waste but developed no glacier? The present continental dry climate of the dry taiga region is unfavorable for glacier development. On the other hand, the existence of permanently frozen ground in this region is favored by the dry, cold winter, whether it was produced under climatic conditions of the past or present.



FIG 7—Sedge tussock swamp in former watercourse in reed semiswamp of *Calamagrostis*. The tussocks have not yet sprouted



FIG. 8—Boulder bed exposed on the valley floor



FIG. 9 Shrub tundra (*eruk*) in summer Dwarf birch shrubs (*Betula exilis*) cover the surface of the swampy valley floor



FIG. 10—Boulder bed exposed on hillside

We cannot but remark on the curious contrast between the regions covered by the great inland ice sheets in Europe and North America, where now there is little or no permanently frozen ground, and the unglaciated region of eastern Siberia, where there is a well-developed permanently frozen subsoil. We do not here attempt a correlation between the Pleistocene ice age and the time when the boulder bed in this region originated. But it would seem natural to consider that, as the climate of Europe and North America recovered gradually and with minor oscillations from the glacial age to its present condition, so the climate of eastern Siberia gradually recovered to its present condition after the boulder bed was produced.

It is recognized that in the adjacent regions of Mongolia and North China there has also been a gradual amelioration of climate from the aridity that led to loess accumulation. Can this dry period be correlated with the dry, cold period during which the vast boulder bed was produced? If the climate then was drier and colder than that of the present, it would probably have been one of the severest in the world. Even the larch would migrate to more favorable areas, and the barren ground would spread widely; the Arctic tundra would be directly connected with the continental steppe. Perhaps the permanently frozen subsoil has been inherited from this period of intense cold. The jernik sphagnum swamp as well as the patches of barren ground may be the evidence of past coldness and dryness which still linger over this region. At any rate, it is again emphasized that even then Siberia was the dry and cold Siberia of today, its unique character simply intensified.

THE NATIVE HUNTER

If the vegetation of the region reflects its steppe-tundra character, so does the mode of life of the inhabitants. The aborigines are hunters, Orochons, belonging to the northern Tungus. We first encountered them a six days' march from Dragachenka, in a meadow along the Gan. These were Horse Orochons, so called because they raise horses. In the central and northern part of the region are Reindeer Orochons. They are immigrants from Siberia and are erroneously called "Yakuts" by the Horse Orochons. Usually the two do not communicate with each other.

The camp of Horse Orochons seen by us was their winter quarters. In summer they migrate to the upper Gan within reach of the forest steppe, following the roe deer and hunting moose. In the migrations the horses are used as transport animals; in hunting they are of course used as mounts. Roe deer and horses are grazing animals. Shortage of forage in the upper forest limits the territory of the Horse Orochons. Cut off thus from the upper



FIG 11—Horse-Orochons of the Gan in winter dress. The child suffers from trachoma.



FIG 13—Reindeer-Orochon in hunting dress.



FIG 12—Horse-Orochon dwelling. These yurts are generally found at the edge of the open forest.



FIG 14—Reindeer-Orochon dwelling. Thin strips of reindeer meat are drying on rack in foreground.

Bistraya, they resort to the large rivers such as the Gan where the forest steppe penetrates deeply into the forest. But in the lower parts of these valleys their territories are being occupied by pioneering Russian and Chinese farmers. Consequently, the Horse Orochons, called Ganchen, Kumarchen, and so on according to the name of the territorial river, form isolated groups, though they do sometimes invade the Bistraya drainage basin when following moose tracks. On the other hand, we discovered signs that the Reindeer Orochons had already penetrated the upper Gan area.

The Orochon house is a yurt (Figs. 12 and 14). The framework consists of some 37 or 38 poles of larch or birch gathered into a conical shape; the base diameter is about four meters. It is covered with reed mat or birchbark in summer and with hides in winter. Household furnishings are even fewer and simpler than those of the pastoral nomads of the steppe, not because the Orochons' standard of living is lower, but because they possess neither wagon nor sledge for transportation owing to the impassability of their habitat. It is not necessary to carry the yurt frame, for trees are abundant everywhere. Except for the many wooden tools, equipment is provided by the game—clothing, boots, mattress, and bag from hide, string from tendons, and needle from bone. Rifle, ammunition, knife, ax, saw, matches, cooking apparatus, cup, hat, shirt, handkerchief, and rings and other ornaments come from the outside world.

Meat and fish are the most important articles of diet. Mare's milk is used. Edible plants include wild *Allium* and some kinds of mushrooms. But besides such indispensable articles as flour, millet, salt, and tea, there are vegetables, oil, sugar, strong drink, tobacco, opium, medicine, and so on which must be bought from traders.

Accordingly, their hunting is both for self-sustenance and for exchange. Among game animals, roe deer is hunted for sustenance, moose half for sustenance, half for exchange. The other animals, including wapiti (*Cervus canadensis*), lynx (*Lynx lynx*), wolf (*Canis lupus*), otter (*Lutra lutra*), mink (*Kolonocus* spp.), ermine (*Mustela* spp.), and wild boar (*Sus leucomystax*), are hunted for exchange.

One of the Horse Orochons of the Gan told us that 40 to 50 roe deer, 5 to 10 moose, and 2 or 3 wapitis were killed by a family in a year. The number of other animals varied. Roe deer are hunted at any season, moose in June after wapiti hunting is over. The velvet antlers of wapiti as well as the embryo and the tail command a high price in the Chinese materia medica, and the animal is hunted enthusiastically. Squirrels and other fur animals are, as a rule, hunted in winter.

However, the nomadic hunter's life is precarious. If he could domesticate the wild animals on which he depends, life would be more stable. Why cannot the hunters of the forest raise moose instead of reindeer?

Failure to domesticate the wild game cannot be attributed to the native's inability or inferiority. It is probable that suitable animals for domestication were lacking. The game animals are shy and solitary; they must be hunted one by one. But where the animals are gregarious, such as the wild sheep and wild horses of the steppe and the wild reindeer of the tundra, a hunter can follow the nomadic life of the herd. If a symbiotic relationship between man and animals were established through some opportunity or crisis, domestication would begin.

The origin of domestication is a complicated problem. The concept of a universal succession from the hunting stage through the pastoral stage to the agricultural stage is untenable. Why the hunter of the taiga is still a hunter after many thousands of years, while the hunter of the steppe or the tundra is already in the pastoral stage, is readily understood. There is no need to mention agriculture, for it is impossible on the poor soils of large parts of this region.

Thus the hunting life of the Orochons is ecologically a climax phase, adapted to the habitat, as the taiga is considered a climax phase of vegetation. At the same time their hunting, utilizing horses for widening the hunting grounds and rifles for facilitating and ensuring success, is technically no less inferior than the agriculture of Chinese farmers.

The drainage basin of the Bistraya is the territory of the Reindeer Orochons; for here *Cladonia*, the indispensable food of reindeer, grows everywhere on the patches of barren ground. The occurrence of this tundra vegetation element in the southernmost part of the dry taiga is due to the high elevation. But the Reindeer Orochons, like the Horse Orochons, could not develop a purely pastoral life because of their marginal situation for reindeer raising. Forest between steppe and tundra is forever the land of hunters.

Use of the reindeer by Reindeer Orochons is similar to that of the horse by Horse Orochons, except that the reindeer is only used by women and children for riding. Neither Orochon eats his domestic animals, but both drink the milk. Their livestock, either horses or reindeer, are treated as symbols of wealth and are used as betrothal presents. In the economy of the Reindeer Orochons the moose takes the place of the roe deer of the Horse Orochons. More roe deer than moose are taken, but the larger size of the moose makes up for the smaller number.

The fundamental mode of life of the two Orochons is similar. But we were impressed by the pleasanter and more prosperous outlook of the Reindeer Orochons. In winter or for hunting they wear robes and trousers made of moose hide (Fig. 13), but both men and women dress in smart Russian style when they go to a town. In other aspects of material culture also, their taste seems to be more civilized.



FIG. 15 Reindeer caravan crossing the Tahlunho

Whence does this difference spring? First of all, it is attributable to the difference in the number of game animals. The territory of the Reindeer Orochons harbors more game animals than the territory of the Horse Orochons. The average numbers taken by nine families in a year are: 7 moose, 5 wapitis, 129 squirrels. The most competent hunters bagged 14 moose. This corresponds to an income three times as great as that of the Horse Orochons, if converted into money. The items of expenditure in a year by six families average as follows: food, 53.4 per cent; clothing, 33.0; miscellaneous goods, 9.5; tax, 3.0.

It is noteworthy that some Horse Orochons were engaging in military service at the time of our expedition. A minimum living was thus guaranteed them, but they could no longer devote their full time to hunting.

CULTURAL CONTACTS, EASTERN AND WESTERN

The different impressions created by the Horse Orochons and the Reindeer Orochons must be attributed, in part at least, to the different cultures with which they were in contact. Chinese culture unhappily introduced

opium among the Horse Orochons—83 opium users are reported among 138 Horse Orochons above 25 years of age in the more southern part of the Great Khingan. But that culture offered no substitute for their shamanistic religion or their primitive funeral customs. The coffin laid upon a tree was observed several times in the drainage basin of the Gan.

The Russian culture, with which the Reindeer Orochons were in contact,



FIG. 16—Reindeer-Orochon canoe on the Albazikha

certainly brought in syphilis and other evils. Nevertheless, it was also the Russian culture that converted the Reindeer Orochons to Greek Catholicism and raised them out of barbarism. Has this cultural difference been responsible for the fact that the Russians have succeeded in colonizing Siberia, whereas the Chinese abandoned the rule of the Ussuri region and Outer Mongolia?

THE PIONEER FRINGE

From the Bistraya drainage basin we crossed to that of the Albazikha and after several days arrived at one of the alluvial plains of the middle river, where we found a small Chinese settlement called Tsilindzi. Amid the summer flowers carpeting the ground stood six houses, two of them empty. In one house lived Wan and his wife, their two children, and a summer laborer from Moho. In each of the remaining three lived one man.

This settlement was established in 1920 by Wan and his friend, who entered the region for hunting and in search of gold. Cultivated fields covered some five hectares; 460 kilograms of spring wheat or 880 kilograms of oats are harvested to a hectare; potatoes and vegetables are also raised.

Wan, the richest, possessed one horse, three pigs, twenty chickens, one goose, and a dog. This is poor farming as compared with that of the Russian colonists in the forest-steppe region.

The characteristics of Russian agriculture in this pioneer fringe are: (1) the large acreage per capita; (2) the combination of farming and ranching; (3) the use of machinery. Where the three are found together, an agriculture is practiced that is adapted to a marginal region, such as this is. The forest steppe we saw corresponds to 40° – 45° of Kira's warmth index and 4.0–6.0 of his humidity index. The black soil is well suited to agriculture, but the late spring frost is a hazard.

In these respects Tsilindzi is more unfavorable than the forest-steppe region. Here the warmth index is 35° – 40° . The climatic adversity is clear from the following calendar:

In the middle of May the soil is plowed and wheat and potatoes are sown. At the beginning of June oats are sown. In July and August the hay is harvested. At the end of August oats and potatoes are harvested, and at the beginning of September wheat is cropped. In the middle of September snow begins to fall and rivers and soils begin to freeze; they remain frozen until the beginning of May of the next year.

In the forest-steppe region the Russian farmers preferred to cultivate the hillsides rather than the valley floors, because of the lower frost incidence. The same condition may obtain in Tsilindzi; but here, except for the valley floors, there are only forest-clad mountain slopes with their underlying boulder beds or with immature, slightly podzolized, thin soils above the frozen subsoil.

Thus the farmers of Tsilindzi do not seem to be able to increase their arable land. They selected dried meadows and dried sedge swamps because these are most suitable for plowing. They said that meadow rue (*Thalictrum aquilegifolium*) indicated cultivable soil.

The shortage of pasture or hay products limits stock raising. Scarcity of grasses and herbs is a characteristic of the coniferous forest in the taiga region. Timber may be cut down or burned off, but the undergrowth of heath, moss, and lichen still persists. Even if heath should be removed, it is doubtful whether good forage grass could be cultivated.

The valley-floor vegetation in Tsilindzi is transitional from shrub or moss tundra to reed swamp. Farmers can use *Calamagrostis* for feeding their animals, but it is well to remember that the limit of the successful cultivation of hay probably coincides with that of the successful cultivation of grains, which is also represented by the 35° line of warmth index. Beyond that line,

only the reindeer, an animal of tundra derivation, can be raised, even if horses and cattle could be kept under controlled conditions.

We see a parallel land utilization in Sakhalin. There the 35° warmth line runs obliquely from northwest to southeast between 49° and 50° of latitude. The southern limit of the shrub and moss tundra lies near the mouth of the Poronai, where the reindeer is raised by the natives.

In such a settlement crop failure spells disaster; for the farmer, with no dairy cattle, has barely enough for self-sustenance. And, indeed, the poor crops of spring wheat in 1940 and 1941 made the settler Wan decide to remove to Moho in the autumn of 1942.

But in this region the real pioneer is not the farmer but the gold miner. For example, the poor settlement of Tsilindzi, isolated in the taiga as an island in the ocean, became unexpectedly connected with a gold mine, Fukushima. There the farmers sold grains, vegetables, hay, eggs, and pigs at high prices. In other words, agricultural activity depends on mining, with all its instability and mobility. The farmer no less than the miner is an opportunist, unrooted in the soil.

One might have expected small settlements of this kind to be scattered throughout the marginal part of the Great Khingan after the Chinese expansion into Manchuria; but Chinese agriculture, which could not adopt the dairy industry in spite of its contact with the pastoral nomads of Mongolia, failed in its northward development. On the other hand, agriculture supported by dairy products achieved the conquest of Siberia for the Russians. However, the dry taiga region of eastern Siberia, especially the part beyond the 35° warmth line, which is more or less reflected in the Great Khingan, may be one of the most infertile lands in the world. It is not at all certain to what extent even Soviet Russia could cultivate it in the near future.

OCEAN CURRENTS IN THE MARSHALL ISLANDS

M. W. DE LAUBENFELS

IN THE summer of 1949 the author made an intensive study of the Porifera of the Marshall Islands, with generous help from the United States Navy and from the Marshallese themselves. To aid in correlating the geographical distribution of the various species of Porifera with the currents that may transport their larvae, a search was made for information about currents. Eniwetok and Bikini, which lie to the northwest of the main Marshall group, have of course received considerable attention in recent years, and the currents in their vicinity have been studied exhaustively by Barnes, Bumpus, and Lyman.¹ Little material was available, however, on the currents of the main island chains, either from the naval authorities or in published sources, and the author therefore made considerable effort to record the knowledge of expert native navigators. It is entirely possible that this knowledge, though based on human experience and the behavior of dugout canoes, is of comparable value with the study mentioned above, in spite of the fact that there the observations were made with Nansen bottles, protected and unprotected reversing thermometers, bathythermographs, and other excellent scientific equipment. It is, however, confidently believed that the modern instruments would confirm the data given here.

BASIS OF NATIVE OBSERVATIONS

It has long been vital to the Marshallese to have accurate information about the currents around their home. In the large lagoons of the atolls, inside the barrier reefs and islets, the natives use outrigger sailing canoes about five meters (16 feet) long. These can be rowed or paddled effectively, and, in any case, any course points to shore. But interisland travel is very different. Until a century ago, such travel was possible only in "homemade" canoes, and these are still used; they are larger, usually 8 meters (26 feet) long, and decked over and are sailed by a small crew. A dead calm at sea is serious indeed; no amount of effort on the part of the crew can take their craft to safety before the supply of drinking water is exhausted.

Every time a native sailboat was becalmed, its crew paid careful attention to the rate and direction of drift. If they succeeded in reaching land, they

¹ C. A. Barnes, D. F. Bumpus, and John Lyman: Ocean Circulation in Marshall Islands Area, *Trans. Amer. Geophys. Union*, Vol. 29, 1948, pp. 871-876.

reported their experiences with great exactness. The older navigators thus accumulated a dependable store of information. Many scientists who value only complex instruments may belittle the words of natives, but practical naval experts (for example, Captain John Vest, former governor of the Marshall Islands) recommend serious reliance on them. Special mention may be made of Lokrap of Ebon Atoll, whom the present author regards as the

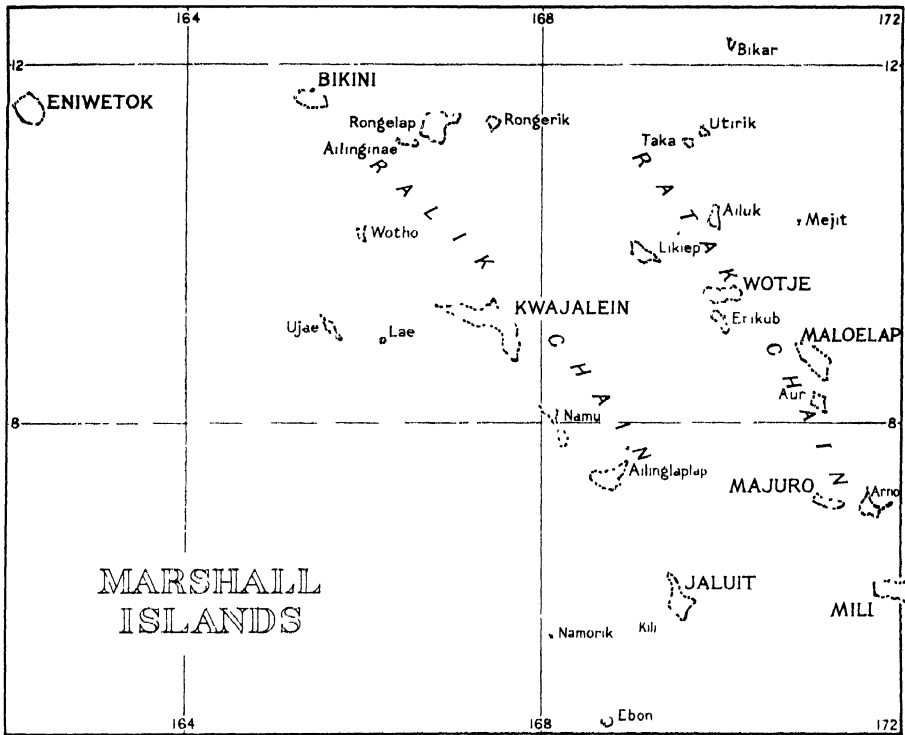


FIG. 1

greatest of the surviving wise old navigators. The younger Marshallese do not carry on the old skills but prefer rather to get a Diesel engine and forget about currents.

The Marshallese natives are not only honest but cautious. For instance, they have repeatedly called attention to the fact that their observations of currents are made in calm weather, and that calms occur chiefly in summer (June to September), almost never in winter; they realize that current conditions in winter may be different.

A good deal has been written in German about *Dünungen* in connection with native navigation in the Marshall Islands, and it is noteworthy that the investigating scientists depended, quite properly, on the method of multiple

interrogation of competent natives. These researches center about the complex stick charts that the natives effectively used. It was once thought that these had to do with currents, but actually they indicated the characteristic shape, pattern, and direction of swells or wave masses (*Dünungen*) among the Marshall Islands. Currents are barely mentioned in the extensive discussion of *Dünungen* in Krämer and Nevermann's comprehensive monograph.² The stick chart was useful for showing in what direction the land lay and therefore in what direction to steer when the wind came, but not for determining the direction of the currents.

THE CURRENT PATTERN

The main body of the Marshall Islands offers an especially interesting problem with regard to ocean currents because it lies directly athwart the well-known Equatorial Countercurrent and between the two westward-flowing Equatorial Currents. Thus the surface currents flow eastward, right into the teeth of the trade winds. The islands are grouped in two northwest-southeast chains, each consisting of atolls so large, and interatoll gaps so small, that they could be expected to have a profound effect on the countercurrent. Yet it continues past the islands in practically full strength.

The western chain of atolls, called the Ralik or "Sunset" chain, extends roughly from latitude 10° N. to latitude 6° N. Of these 400 kilometers, some 230 kilometers are barred by solid atoll reef. The largest single gap (some 47 kilometers) is between Ailinglaplap and Jaluit. Yet this gap seems to be as tightly closed against the passage of the current as though a wall were present. What is the mighty invisible force that deflects the stream? The possibility of an extensive shoal will be discussed below.

The eastern chain of atolls, the Ratak or "Sunrise" chain, is longer than the Ralik chain. Of its 520 kilometers (5°); some 300 kilometers are barred by solid atoll reef.

The general current pattern of the Pacific is, of course, well known. Just north of the equator a current flows eastward; it is called the Equatorial Countercurrent. On each side of it a larger current flows westward, the North Equatorial Current and the South Equatorial Current. The lateral boundaries of these currents are not straight lines, and it is of some interest to map them.

Barnes, Bumpus, and Lyman³ mention "a generally westward set of the

² Augustin Krämer and Hans Nevermann: *Ralik-Ratak (Ergebnisse der Südsee-Expedition 1908-1910, edited by G. Thilenius, II. Ethnographie, B. Mikronesien, Vol. 11), Hamburg, 1938.*

³ *Op. cit.*, pp. 874 and 875.

current between the latitudes of 8° N and 17° N. The drift of this North Equatorial Current averages approximately one-third knot over most of this latitude range, but is variable with a maximum of nine-tenths knot west of Bikini Atoll." They continue: "South of 7° N the Equatorial Counter Current sets eastward. The velocities obtained from dynamic calculations were as high as two knots."

The Marshallese navigators place the southern boundary of the North Equatorial Current at $9^{\circ} 30'$ N. in the western part of the archipelago; that is to say, near Ujae and Lae Atolls. To the east their boundary lies farther north; near Kwajalein it is at 10° and near Ailuk at $10^{\circ} 30'$ N. They too place its greatest force at about the latitude of Bikini and Eniwetok. They also place an intermediate zone, with fickle currents or none, just north of Kwajalein, extending eastward between Likiep and Wotje.

The northern boundary of the Equatorial Countercurrent they place just south of Kwajalein and Wotje, about 9° N., but varying from a lower latitude west of Kwajalein to a higher latitude east of Wotje. Barnes, Bumpus, and Lyman give it as only 8° N. in the region they studied, well to the west of Kwajalein.

The southern boundary of the countercurrent is, of course, equally vague. Clearly, however, the current is still strong as far south as 4° N. From the natives' reports it seems probable that it is still fairly strong as far south as 3° N. Barnes, Bumpus, and Lyman (Fig. 6, on p. 875) indicate that the easterly current is still in effect south of the equator. This is here regarded as needing further investigation, and thus possible revision. The Marshallese certainly ran out of the countercurrent and into a strong westerly current only a day's sail, or at most a very few days' sail, south of Ebon.

The author discussed the northern boundary of the South Equatorial Current with a Gilbert Island navigator as well as with the Marshallese. The result would seem to place this boundary not south of the equator but instead at about 1° or 2° N.

A prominent feature of the current pattern indicates that the Gilbert Islands, immediately to the south of the Marshalls, exert a considerable influence: where the countercurrent passes the Gilberts, its southern boundary seems to be exceptionally far to the north. The natives of Ebon insist that a current often—perhaps usually—runs from the Gilberts toward their island. They reported that articles which had evidently come from the Gilberts frequently washed ashore. But these articles may first have floated northwest, reached the countercurrent far west of Ebon, and then been borne eastward and northeastward. Some further confirmation of the Gilbert-to-

Ebon current is given by Erdland,⁴ who comments on the number of Gilbert Islanders in Ebon—a fact also noted by the present author.

We may, then, place the boundaries of the Equatorial Countercurrent at 170° E. between 2° and 9° N. At this latitude it is not a single stream, but double, with a quiet strip in the middle, a maximum at 5° N., and another, nearly as strong, at about 8° N.

EON WOERR, THE SHALLOW SEA

The Marshallese emphasize the, to them, well-known current-free sea south of Ailinglaplap, extending east and west for more than a degree of longitude and south to a line between Namorik and Jaluit. They call this quiet sea Eon Woerr. Literally this means "over coral," but those who spoke English translated it "shallow sea"—they well know that coral exists only in shallow water. They consider, and are quick to elaborate the thesis, that this part of the "open" Pacific is really like a lagoon inside an atoll. Most of them eagerly asked the author if modern instruments confirmed their belief. The charts available from the Hydrographic Office showed no soundings within the area but did show many around its periphery, ranging from 2202 to 2781 fathoms (4000 to 5000 meters). One Marshallese, whose veracity is above question, told the author that the Japanese had taken soundings in the area and reported that there was indeed a huge shoal. The Marshallese vigorously maintain that this current-free sea reacts to tides exactly like the lagoon of an atoll, and they have taken great interest in determining the entrance to this "lagoon" of invisible walls. They state emphatically that there is such a channel, to the east of Namorik, between Namorik and the small island of Kili.⁵ It is interesting that the channel is west of Kili, not, as one might expect, between Kili and Jaluit. Through this channel, when the tide is rising, the water streams northward into the "shallow sea"; when the tide falls, the water rushes out with equal force back to the south.

The Marshallese agree that a strong current, of about a kilometer an hour, flows eastward north of Ailinglaplap, continues northeastward toward Maloelap, and divides near that island, more going to the north of it than to the south. Farther east they had little occasion to go. They agree also that a stronger current, of about two kilometers an hour, flows south of Namorik and north of Ebon, south of Jaluit, and east-northeastward toward Mili.

⁴ P. A. Erdland: *Die Marshall-Insulander* (Collection Internationale de Monographies Ethnologiques, Vol. 2, No. 1), Münster, 1914, p. 12.

⁵ This island has now become famous as the place where the dispossessed inhabitants of Bikini have finally been settled.

This current also fans out and divides; the northern part curves farther and farther to the north, past Majuro, to join the southern part of the Maloelap split at the small atoll of Aur. This arc or curve is so well known that there is a long-established name for it—Lole-lap-lap, or “big wreath” (*lap* means “large,” and doubled it means “very large”; *lole* corresponds to the well-known Hawaiian *lei*, “wreath”).

An example of how the natives know about these currents is contained in one of Lokrap's many narratives. On one occasion his vessel was caught in a dead calm just south of Jaluit. Three days later, still in dead calm, the vessel landed at Mili. As the supply of drinking coconuts was sufficient for a week, he and the crew were none the worse. The current, unaided, had carried them 200 kilometers in less than 70 hours, or almost exactly three kilometers an hour—more than 40 miles a day.

FIVE CITIES OF THE GANGETIC PLAIN

A CROSS SECTION OF INDIAN CULTURAL HISTORY

O. H. K. SPATE AND ENAYAT AHMAD

THE United Provinces of Agra and Oudh, although not the most urbanized of the political units of India, is¹ perhaps the most interesting to the urban geographer. Only 12.5 per cent of the population were returned as urban in the census of 1941, a little less than the all-India average; but of the 57 towns with 100,000 people or more, 12 were in the United Provinces, and of the 17 with more than 250,000 the United Provinces had five, in both cases the largest number in a single province.² In smaller towns the position of the United Provinces is not so striking, but there is a remarkable, and on the whole even, spread of middle-sized centers, especially in contrast with the other Gangetic provinces, Bihar and Bengal. This is to some extent a matter of administration. In consequence, much work done in minor centers in Bengal and Bihar is carried out in the United Provinces at the district headquarters, and this greater administrative and legal centralization has fostered the growth of a large number of middling towns—no fewer than 41 between 20,000 and 50,000.

DISTRIBUTION OF TOWNS IN THE UNITED PROVINCES

The reasons for the high degree of urban development in the United Provinces seem to be largely historical. This is borne out by the distribution. The census records 456 "towns," many of which of course are hardly more than large villages; indeed, at the bottom of the list the criterion is avowedly subjective. The actual number is 427; the rest are railway colonies or cantonments contiguous to a town proper. Of this number just half (214) are concentrated in a western zone covering about 25 per cent of the area of the United Provinces; this zone also contains 15 of the 23 towns of more than 50,000 inhabitants (Fig. 1). The historical factors seem to include the stra-

¹ Inasmuch as the distinction between Agra and Oudh is now negligible, it seems reasonable to use a singular verb with the United Provinces, on the analogy of the United States of America.

² All figures of population are taken from the 1941 census. Comparison with other provinces does not take into account postpartition mergers of states, which, except in Bombay, have added practically nothing to urban totals and do not affect the position of the United Provinces. Without Pakistan, this position is still stronger: 12 out of 49 towns with more than 100,000 inhabitants, 5 out of 15 with more than 250,000.

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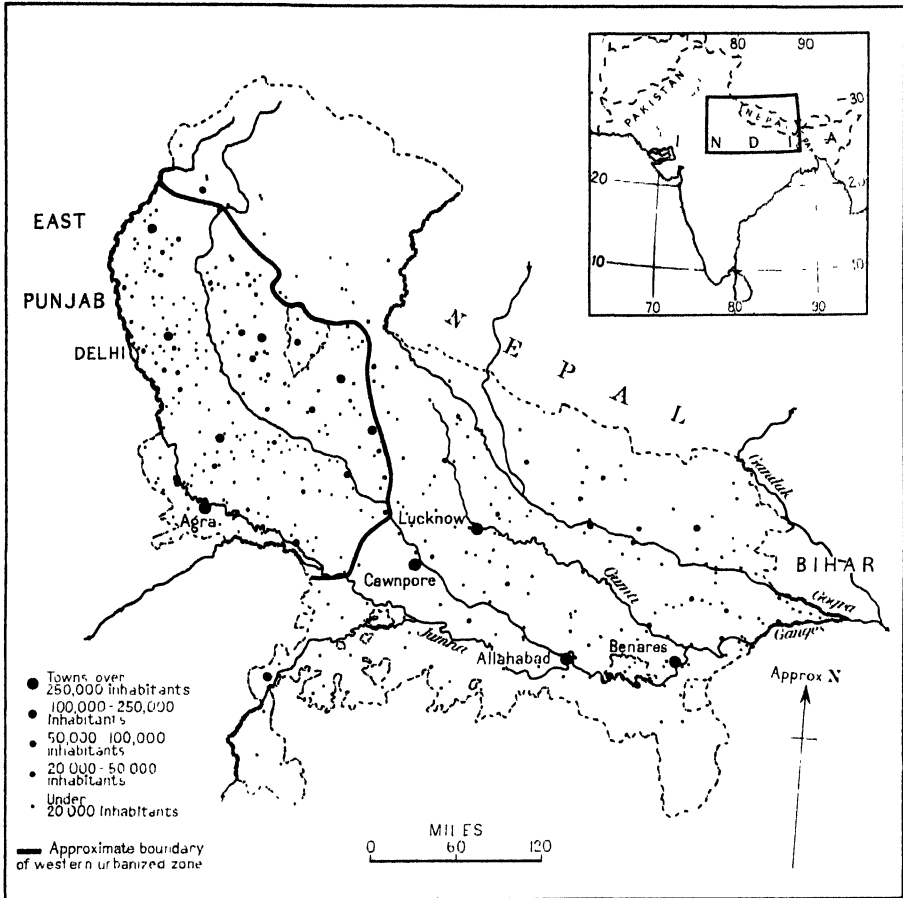


FIG. 1—United Provinces, showing distribution of towns

tegic importance of this western zone as a Muslim-Rajput marchland—the waves of invasion from the west often spent themselves in the Jumna-Ganges Doab, and many of its smaller centers are obviously the descendants of groupings around petty forts—and, rather later, the general economic and administrative activity consequent on the proximity of the imperial capitals of Delhi and Agra. This area was also the base for penetration into the Deccan by the Malwa passageway. The eighteenth century saw the rise of local powers in Rohilkhand and Oudh, the nineteenth the development of a fairly close road and rail net and canal irrigation. With this went the growth of a rural economy depending to a considerable extent on the marketing of surplus agricultural produce; and owing to the relative aridity and the consequent concentration on water points and to the stormy earlier history and the consequent defensive nucleation, there were a large number of com-

pact villages capable of becoming local market centers. Aside from this western zone, the only area with a fairly dense concentration of towns is a strip along the Ganges between Allahabad and the Gogra confluence. The general strategic value and nodality of this belt in the days of water transport hardly need stressing, and it was naturally one of the first areas to be reached by roads and railways from Calcutta. It has seven of the 23 large towns.

THE FIVE CITIES

The 11 towns with 100,000 population or more accounted for 37.5 per cent of the urban population in 1941, but five cities alone contained 24 per cent. These five, in order of size, are Cawnpore, Lucknow, Agra, Benares, and Allahabad, each of which has more than 250,000 inhabitants. Together they form a curious cross section of Indian cultural history. Benares and Allahabad represent the heroic and medieval ages of Hindu civilization; Agra is a relic of the Mogul heyday, the apogee of Islam in India, and Lucknow of the post-Mogul Muslim decadence; Cawnpore typifies Indo-British civilization, both in its earlier "John Company" phase and in that of the modern economic revolution.

Before considering them individually, we may note that their distribution is converse to that of general urbanization. Of the five only one, Agra, is in the western urban zone; the others are dominant in their own regions, and it would seem that they have inhibited the growth of other urban centers within their immediate range. Within a radius of 50 miles around Allahabad there is only one town in the 10,000-20,000 class; within 30 miles of Lucknow there is no town with more than 20,000; in Cawnpore District there is only one other town, with a population of only 5000. Cawnpore and Lucknow, it is true, are fairly close (some 45 miles by rail), but, as we shall see, the rise of Cawnpore is relatively recent, and historically the two might in a sense be regarded as twin cities. In the west, on the other hand, the pattern of town distribution in some areas closely approximates Christaller's hexagons.³ All this seems to suggest a sort of struggle for existence, the presence of many smaller centers inhibiting the growth of master towns and vice versa.

BENARES

The origins of Benares or Kasi (263,100 in 1941; Fig. 2) are unknown but very ancient; at its old site, Sarnath, a few miles to the north, is the deer park where Gautama Buddha began his mission. Benares is, of course, pre-

³ See R. E. Dickinson; *City Region and Regionalism*, London, 1947, pp. 30-35.

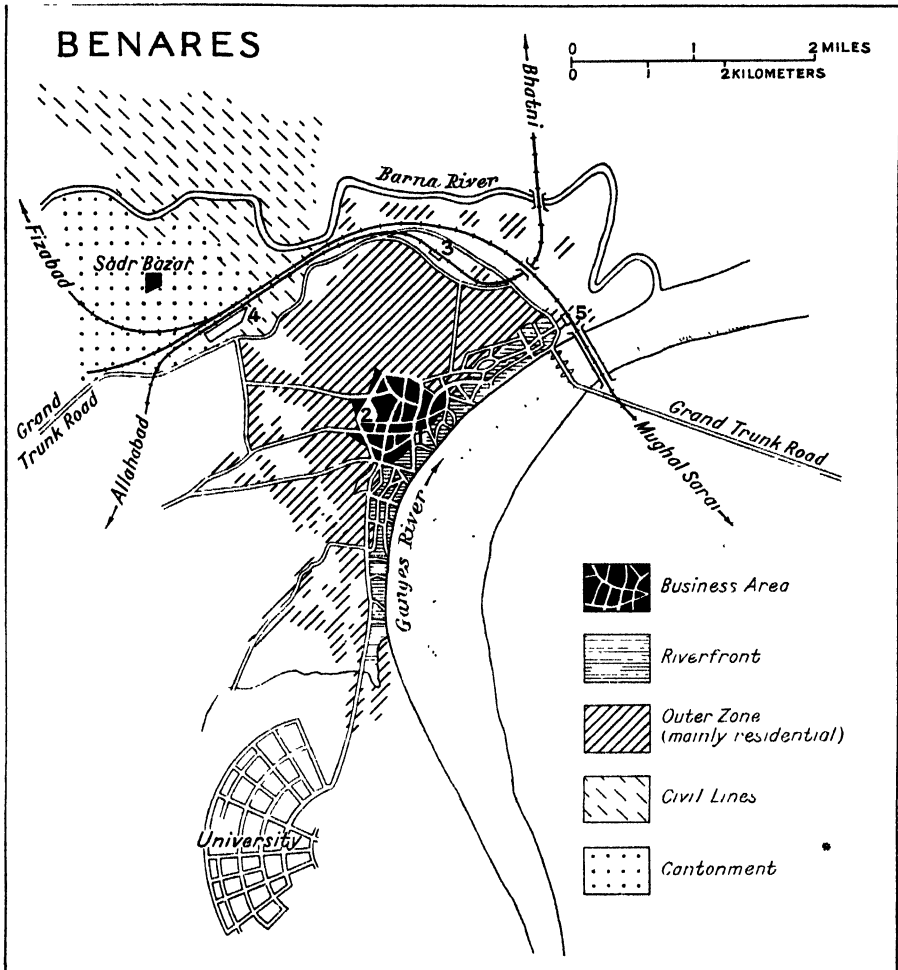


FIG. 2—Key: 1, Chauk proper; 2, Victoria Park; 3, City Railway Station; 4, Cantonment Railway Station; 5, Kasi Railway Station.

eminently a center of Hindu devotion, traditionally the first spot on earth created by Vishnu. Like many other Hindu sacred sites, it is at a river confluence, though the Barna can hardly be regarded as a particularly classic stream; in theory, however, its insignificance is more than compensated by the convergence at the Panchganga (Five Rivers) Ghat of five streams, of which "the Ganges alone is visible to the gross material eyes" of geographers. During the Muslim invasions, so prominent a center of Hinduism fell on evil days; the intolerant Aurangzeb built the dominating mosque with the stones from demolished temples. Most of the temples are thus relatively recent; many were built by Mahratta or Rajput princes in the eighteenth century.

The most important factor in its siting is the four-mile-long ridge of *kankar*, a concretionary calcareous formation found in the older Gangetic alluvium, that forms the outer side of the Ganges bend. The high, stable bank, trending north-south and thus allowing the ghats (intervisible owing to the concavity of the bank) to receive the morning sun, and the sanctity of the Ganges waters combine to make the river front the natural dominant in the morphology of the city. The curving shore is lined with great flights of steps, the bathing and burning ghats, with massive temples, in turn tawdry and splendid, with monasteries and the palaces of princes from all parts of India. Behind these is a labyrinth of narrow, fetid alleys, overhung by tall galleried houses, and interspersed with innumerable shrines, "ranging from a shapeless fragment of stone smeared with vermilion to magnificent temples."⁴ The streets are crowded with priests, mendicants, and touts, and their pilgrim clientele, and through the turmoil the sacred bulls of Shiva lounge arrogantly.

The business center is roughly coincident with the *Chauk*⁵ ward; in the southeast religious interests predominate, and here a large trade is carried on in images, sacred threads, and other essentials of Hindu ritual. To the north-west is the commercial area with its bazaars, and beyond it the mud houses of the weavers who form the largest part of the industrial population. To the west and south of this close-packed core are the better residential suburbs, with *pukka* (brick or stone) houses and gardens and frequent enclaves of cultivated fields. Still farther out are the cantonments and the civil lines,⁶ and to the south the Hindu University.

Although Benares is a rail and road focus with fairly wide commercial contacts, occupationally it is very different from the other cities, except perhaps Allahabad. "Industry" is mainly small-scale artisan production: in 1941 factory workers numbered fewer than 4000, about half of them in the Benares Cotton and Silk Mills, but there were nearly 25,000 hand looms and 50,000 weavers, including women and children. The proportion of workers in cotton spinning and weaving is slightly higher than that producing the silk fabrics and embroideries and gold and silver threadwork for which Benares is famous; *sari* borders especially find an all-India market. Jewelry and brassware (images, and utensils to which some sanctity is attached) are also important. The fine textiles, jewelry, and brassware are

⁴ All quotations in this article are from the Imperial Gazetteer of India or the District Gazetteers.

⁵ *Chauk* implies variously a high street, a crossroads, or a ward but always indicates the busiest bazaars or the commercial core of the town.

⁶ The cantonments are the barracks quarter, laid out with mathematical regularity. Their own bazaar enclaves serve the troops. Civil lines contain the official residences of the local bureaucracy, with a fair proportion of the more Anglicized and well-to-do professional classes.

obviously associated with the large market provided by the influx of pilgrims and of the well to do who come to Benares to spend their declining days in this most holy of cities; but the brass industry also caters largely to the tourist trade, in suitably atrocious designs. The export trade of Benares consists mainly of the articles already mentioned; the city is an assembling market for wheat, linseed, *gur* (raw sugar), tobacco, and hides and skins, but its market range is small, most of these imports are consumed locally, and only in *gur* is there much trade, with central India and Calcutta.

East of Allahabad, Benares is the most important administrative, educational, and cultural center of the province; the Hindu University, perhaps especially eminent in metaphysical studies, is appropriately located here. But essentially Benares lives on its past, on genuine piety, and on superstition.⁷ Lest this should seem a harsh judgment, it may fairly be said to be but a faint reflection of Mahatma Gandhi's, as given in one of the most striking chapters of his admirable autobiography, "The Story of My Experiments with Truth." Sanctity here, as in many other places, has at times a certain commercial aspect.

ALLAHABAD

Allahabad (260,630; Fig. 3), the ancient Prayag, lies at the junction of the Jumna and the Ganges, obviously a sacred site, and made more so by the legendary underground confluence of the Saraswati, the "lost" river of the Punjab. The great fort in the angle of the rivers was built by the Mogul emperor Akbar. Beneath it, on the dry sandbanks to the north, is held the annual Magh Mela (fair), which attracts between a quarter of a million and half a million people; and every twelfth year the Kumbh Mela brings together what is perhaps the greatest assemblage of human beings on one site, sometimes more than a million people—in fact, the District Gazetteer makes the incredible statement that in 1906 it was estimated that three million people were present.

The pattern of the city is much influenced by the local topography. The Jumna flows immediately below a steep bluff intercalated with kankar, and here the city impinges directly on the waterside, except in the ravine terrain to the west. The Ganges, however, has a relatively wide flood plain, on which there is no building at all. A steep bank, 10 to 20 feet high, marks off the flood plain from a low terrace,⁸ itself bounded to the west by an old

⁷ According to the 1931 census about 3600 people were employed in priestly services (nearly 2 per cent of the population), and of course there are numerous hangers-on.

⁸ The word "terrace" is used in its ordinary descriptive sense, not as a technical geomorphological term.

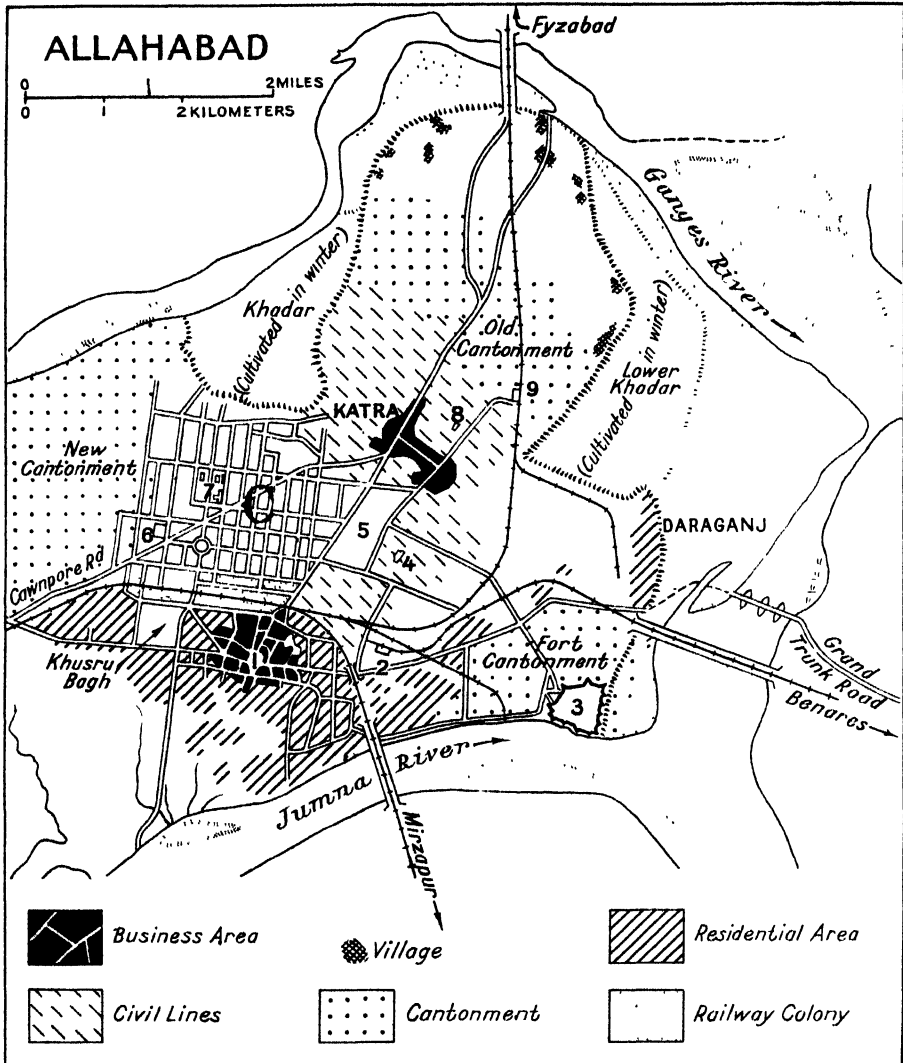


FIG. 3—Key: 1, Chauk proper; 2, City Railway Station; 3, Fort; 4, Government House; 5, Alfred Park; 6, High Court; 7, Secretariat; 8, University; 9, Prayag Railway Station; C, Cannington (part of Civil Lines).

bank of the Ganges. This terrace is liable to inundation in years of abnormal floods, as in 1875 when the embankment (attributed to Akbar) running from Prayag Station to the Fort was breached. There is thus little development east of the railway that runs north to cross the Ganges, and most of the city lies on higher ground to the west, along the axis of the Grand Trunk Road, which appears to follow the old Mogul alignment. As usual, the business section and the main bazaars lie around the Chauk, or central crossroads;

around them are the mainly residential quarters, and immediately to the north is the railway colony, laid out on the usual severely rectangular lines. This blocks access to the north, there being no crossing for wheeled traffic for more than a mile. The railway thus completely shuts off the crowded and irregular Indian city from the broadly planned rectangular cantonments and civil lines, a district of large bungalows and public offices in spacious gardens and compounds. This is a not uncommon feature in Indian town layouts⁹ and probably springs from the British preoccupation with internal security.

Industrially Allahabad is rather insignificant. In 1941 there were some 7000 factory workers, of whom 62 per cent were employed by the Arsenal (situated in the Fort) and another 28 per cent in printing and bookbinding, a clear reflection of the city's importance as an administrative center—it has only recently been replaced as the provincial capital by Lucknow and is still the seat of the High Court. Commercially also, it is not a center of any note, though its position where the railway from the south by the Jubbulpore gap impinges on the east-west lines of the Ganges Valley gives it a heavy through traffic. There are, however, some features of individual interest: if Benares is the most Indian of cities, the civil lines and the Europeanized buildings of the city center set the tone of Allahabad. Except for tiles and glass products its trade can hardly compare even with that of Benares; but in the number of banks it nearly equals Lucknow, and it is second only to that city in the number of lawyers. Educationally it is probably the most important center of the province; in 1931 the percentage of literates in the total population over five years of age was 29, as against 23, 19, 18, and 17 in Benares, Lucknow, Cawnpore, and Agra respectively. The Government Press, employing 1273 persons in 1931, was the largest establishment of its kind in the province. Administration, then, is the mainspring of Allahabad's activities; its nodality is extremely favorable, and its religious significance is second only to that of Benares.

AGRA

Agra (284.149; Fig. 4), the old capital of the Moguls, owes its importance to its strategic site; it is one of the poles (the other is Delhi) of the vital middle Jumna axis. On the one hand is the solidly Muslim northwest, with its strong climatic and cultural affinities with Southwest Asia and its accessibility to waves of invasion and culture contact from Central Asia; on the other the shock-absorbing Gangetic plain, which gave defense in depth to Hindu

⁹ The railroad naturally forms a sharp cultural divide, even where the Indian and the European areas are contemporaneous and planned, as in Rangoon.

India—it has been said that Indian India really begins on the banks of the Jumna at the sacred city of Muttra, 30 miles northwest of Agra. Moreover, here the relatively open and easy passageway into the Deccan via the Deccan lavas of Malwa diverges from the Jumna-Ganges axis. The ancient city of Ujjain, the fortress towns of Gwalior and Jhansi, and innumerable lesser hilltop holds mark the old route to the Gulf of Cambay region, the vitality of which is attested by the importance of Barygaza (Broach) in Roman times and of Surat in the Age of the Discoveries. Agra commands the northern exit of this great avenue of trade and war.

The original settlement lay east of the Jumna and seems to have been a forward base of the Lodi sultans of Delhi (fifteen and sixteenth centuries), to control the refractory magnates of the trans-Jumna borderland. Akbar moved to the strategically better west bank, on the outer side of the vast, gently sweeping curve of the river. Here the riverbank is stable, as is shown by the remains of Mogul buildings of the third quarter of the sixteenth century. The site is more or less level, though in places badly cut up by ravines; Agra is on the edge of the great tracts of wildly gullied badlands along the Jumna and the Chambal.

The city is grouped around the magnificent red-sandstone Fort, built by Akbar about 1566. There was originally a wall running in a semicircle with a radius of about a mile from the Fort; in the north of the contained area lies the business and bazaar center, its narrow streets diverging from the Fort in a roughly radial pattern. The outlying areas are extremely irregular, with ribbon development along the roads to Delhi, Bharatpur, and the west. The civil lines and cantonments are as usual more or less rectangular, and so is the village of Tajganj, around the Taj Mahal. Cottage industries, especially shoemaking, are scattered throughout the close-built area, but most of the modern factories lie in a block to the north of the city proper, along the river.

Agra is one of the leading industrial cities of the United Provinces, in both factory and artisan branches. It is the second center for textile and leather production, ranking next to Cawnpore. The textile industry goes back to Mogul days, when Agra was for a century the imperial capital, with a consequent large market depending on the court. There was thus a considerable supply of weaving labor available for the mills. The city lies in the cotton zone of the United Provinces, and with the coming of the railway it became a center of the raw-cotton trade. Leather manufacture also began with the making of embroidered and otherwise ornamented shoes for the Mogul court. In the 1880's two large shoe factories were set up—an offshoot

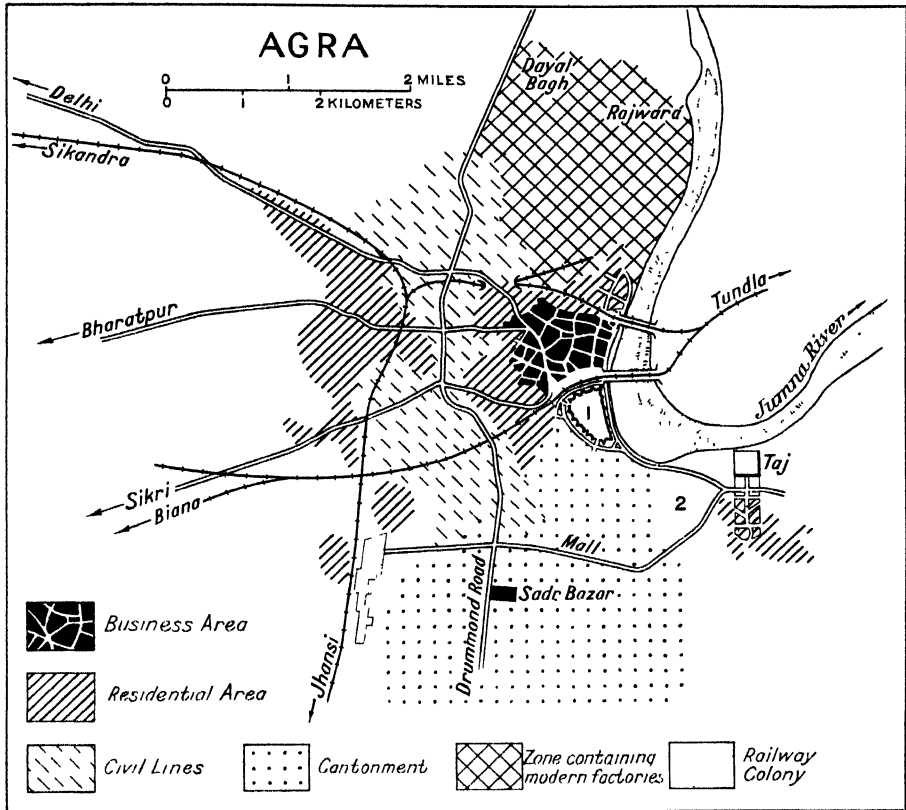


FIG. 4—Key: 1, Fort; 2, Macdonell Park.

of the Cawnpore industry—and although these later closed down, the unemployed labor turned to the home manufacture of European-type shoes on iron lasts. It should be noted that there are large numbers of Muslims and of Chamars, the untouchable caste of workers in leather, in the locality. The presence of these trained groups and the growth of the city as a center of trade in hides and skins provided the bases for the growth of modern tanneries and leather factories. Craft production remains important—gold and silver lace, embroidered caps, carpets and rugs, jewelry, and carved alabaster curios for the tourist trade.

Agra has a high degree of nodality, with the Chambal and Betwa Valleys leading south into Rajputana and Malwa; and it has, as it were, a frontier location where the Gangetic plain, the central Indian foreland, and the Aravalli region all march together. There is thus ample scope for complementary exchanges. Agra is a collecting center for wheat, barley, millet, gur, hides, and skins from the Jumna-Ganges Doab, cotton from the middle

Doab and Gwalior, and stone from the Aravalli and Vindhya areas. These commodities are exported, food grains to Gujarat, gur to Rajputana, cotton cloth and yarn and building stone to the Doab. The city also has administrative, legal, and educational functions.

But when all has been said, Agra remains for India and the outside world the city of the Taj Mahal. Much of the town is filthy, squalid, and ruinous; even the civil lines appear shabby and half-planned, and the suburbs are made more than usually hideous by gaping ravines used as rubbish dumps. But central Agra contains some of the glories of Mogul architecture: the serene strength of Akbar's Fort, the exquisite Pearl Mosque within it, and the little kiosks looking from the Fort walls to the Taj. Less successful is the Jama Masjid (the congregational mosque, roughly the equivalent of a cathedral), its immense domes bizarrely striped in zigzags. For thousands, however, the Taj Mahal symbolizes India. By the time (1632-1648) that Shah Jahan was building this mausoleum for his favorite wife, Mumtaz Mahal, there was some decline from the strength of Akbar's building, and the dazzling white marble is perhaps less pleasing than the rich reds of the Vindhyan sandstone favored in the preceding century. But despite some defects in design, the Taj remains a beautiful building, not least in its setting, a quiet, red-walled formal garden by the river. The inhabitants of Tajganj draw material rather than spiritual rewards from this beauty; since the Jats looted Agra in 1761, few visitors have got away cheaply. Not many tourists go on to Akbar's deserted capital at Fatehpur Sikri, 22 miles away; those who do are richer by an unforgettable esthetic experience. In its originality and daring ingenuity, the vast spaciousness and yet restraint of the mosque courtyard, the combination of the towering magnificence of the great Gate of Victory with the charming fantasy of the smaller buildings, Fatehpur undoubtedly represents the peak of Mogul architecture, at its best perhaps the most satisfying style in the world.

LUCKNOW

If in Agra and Fatehpur we are in a rich dreamland, in Lucknow we have entered the realm of lunatic fantasy. Like the Mogul centers, Lucknow was built on the sordid exploitation of the peasant masses; but at least the Mogul dignity and splendor are tangible evidence of the imperial standards of culture and catholicity of interests, and even the decline shows a formalism and an excessive restraint. But Lucknow is all flamboyance: the clumsy and garish provincialism, bastard progeny of debased Oriental and debased European models, reflects an appalling decadence. There are a few solid and

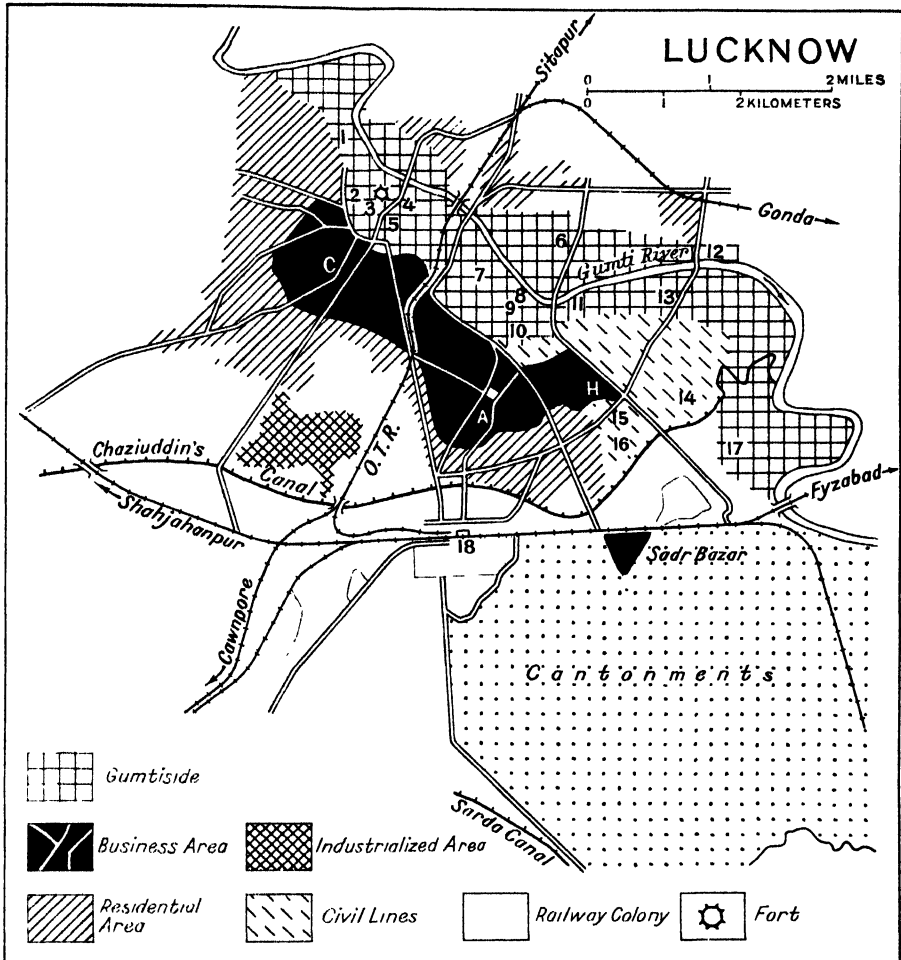


FIG. 5—Key: 1, Shish Mahal; 2, Victoria Park, 3, Bara Imambara; 4, Medical College; 5, King George's Hospital; 6, University; 7, Residency; 8, Chhattar Manzil, 9, Chief Court; 10, Kaisar Bagh; 11, Moti Mahal; 12, Paper Mills; 13, Sikandar Bagh; 14, Zoo; 15, Council Chamber; 16, Government House; 17, La Martinière; 18, Railway Station; C, Chauk; A, Aminabad; H, Hazratganj.

relatively restrained buildings, and it must be admitted that the Nawabs of Oudh have had a bad press; but, all allowance made, their private morals, their public administration, and their esthetic taste seem to have been all on one level, and that depraved. "Some of the most striking buildings, which look like marble in moonlight, are shown by the disillusioning sun to be degraded examples of stucco and brick. Flying buttresses to support nothing but one another, copper domes gilt from top to bottom, burnished umbrellas, and balustrades of burnt clay" form a gallery of architectural horrors matched perhaps only in the Indo-British buildings of Bombay.

Lucknow, though on a crossing of the Gumti on the route from the Jumna-Ganges Doab to the old center of Ajodhya (a regional capital, from which Oudh derives its name), was of little importance until it became the capital of the Nawabs of Oudh in the eighteenth century. Under the Moguls the city began to grow around the fort commanding the crossing, and even under the British the main thoroughfares were built to converge on the fort glacis. The part east of the Oudh-Tirhut Railway (O. T. R. on Fig. 5) and the trans-Gumti suburbs are relatively modern. In shape the city is rather like a butterfly with extended wings. The western wing is centered on the Fort; the eastern has no old cultural focus on the riverside, but streets diverge from the bridges, here all built by the British. The Gumti is not bordered by bluffs, and the water front is liable to occasional flooding; in contrast with the other cities, the riverside strip is avoided by construction, except for a few palaces and public buildings in a long belt of parks and gardens.

Functionally, then, we have the open development (public buildings, Residency, colleges) along Gumtisi, backed by a wide-spreading business and residential area. The markets are more scattered than usual; they began in the west under the Oudh rulers, but under British rule (from 1856) the east received more attention, and the general extension was in that direction. Thus the Chauk ward, the old commercial center, retains most of the silver-smiths, manufacturers, and workers in old handicrafts and some of the chief grain markets, but commercial interests have shifted from this rather decadent section and now lie east of the O. T. Railway; in the extreme east of the close-built area, adjoining the civil lines, Hazratganj contains most of the European shops and offices. Surrounding the central business section is a chiefly residential peripheral zone, with the main hotels near the railway in the southeast; here again the western suburbs lose ground to the eastern. A small area outside the city adjoining the O. T. Railway contains most of the few modern factories; beyond it is the railway colony. The cantonments cover an immense area south of the Fyzabad railway, an area almost as large as that of the city but containing in 1941 only one-fourteenth of the total population. Finally, north of the Gumti is a relatively unimportant Gumtisi strip, with the University and a paper mill.

Lucknow, the capital of the United Provinces, was the second-largest city in 1941, with 387,177 inhabitants against Cawnpore's 487,324. It is only recently, however, that it has been outstripped by Cawnpore in consequence of the latter's industrial growth. Its functions are essentially administrative and commercial. There is relatively little factory industry, and more than half of the factory workers are in the rail shops. The city is, however, an

important center for printing and bookbinding and has a large paper factory. More characteristic, perhaps, are the craft industries: fine embroideries, jewelry, and embroideries in gold and silver thread; and gold and silver wire and foil. Calico printing and the manufacture of chewing and smoking tobacco and perfumes are also significant. These crafts obviously stem from the aristocratic patronage of the Oudh court.

Commercially Lucknow probably ranks next to Cawnpore, with important assembly markets for agricultural produce, and with a provincial or even national demand for its art and luxury products. But administratively and culturally it is first. Both its historic past and its markedly central position favor it as a center of law and government. With its riverside parks, a comparative absence of factories and slums, and some remains of the ease and affluence of the old court days, Lucknow exerts a strong centripetal pull. Its residential attractions are increased by the presence of several colleges, as well as of the University, and better medical services than are to be found in the other cities. It is noteworthy that two of the United Provinces' four English-language dailies are published in Lucknow. Probably more people are merely "living" in it than in any other city of the plain. The communal composition of the population is significant. In 1941 the United Provinces had the largest Muslim minority—more than 15 per cent—among the non-Muslim provinces of the Indian Empire, and, as the intrusive community, an unusually high proportion of the Muslims were urban—30.6 per cent, against an all-India average of 15 per cent. In Lucknow, Muslims were more than 35 per cent of the total population, in Cawnpore more than 23 per cent, in the other three cities a little less than 30 per cent. On the whole, it is not likely that the Muslims' share in commerce and industry has been greater than their numerical proportion; but in the professions and the services they were stronger, owing partly to "weightage" for the minority community in official services, partly to the heritage from the Muslim Kingdom of Oudh. Most of the *taluqdars*, or large feudal landowners, of that kingdom were Muslims, and of course patronage installed them in the services. The high proportion of Muslims in Lucknow probably reflected the existence of this well-to-do class of landowners and retired officials. Postpartition transfers of population will of course have diminished their numbers, and their economic position will be further weakened by the projected abolition of the *zamindari* (landlord) system, it is true on generous terms of compensation.

CAWNPORE

In the late eighteenth century Cawnpore was a mere village, owing its

importance to its selection by the East India Company as a favorable site for a trading factory, accessible by the Ganges waterway, and (in 1778) for a military station, excellently placed for its double role of defending the Company's vassal, the Nawab of Oudh, from Mahratta raiders from the west and of maintaining surveillance over the Nawab himself in his capital, only about 40 miles away. It is now the second-largest inland industrial center of India, outranked only by Ahmedabad. In 1891 it had 194,000 inhabitants, against Lucknow's 265,000; by 1921 it had climbed unsteadily to 216,000 and Lucknow had dropped steadily to 241,000; in 1931 the populations were 243,755 in Cawnpore and 274,659 in Lucknow. The following decade was a period of rapid urban expansion all over India; but whereas Lucknow increased by 41 per cent to 387,177, Cawnpore doubled itself to 487,324. It has since grown rapidly (and without adequate control) under the stimulus of the war industrial demand. The real rise of Cawnpore, in Company days a military and trade station and, like Lucknow, a Mutiny storm center, began when the American Civil War created a sudden demand for Indian cotton. Cawnpore had then just been linked by rail with Calcutta (in 1863), and it promptly became a boom town. "Lands covered with the mud huts of camp-followers were hastily taken up by the authorities. Commissariat elephants were brought out to push down the frail erections in order to clear space for the storage of the bales of cotton, which, piled up level with the roofs, had been blocking every lane in the city. At the same time the ordinary country produce of the [Jumna-Ganges] Doab and of Oudh began to pour in here instead of passing by along the river." The first cotton mills were built between 1869 and 1882, so that Cawnpore is among the older factory cities of India.

The siting has been influenced by the nature of the Ganges banks. To the northwest is a strip of the lower and younger alluvium, liable to flooding; downriver is a high bank intersected by ravines. But at Cawnpore itself the high bank abuts directly on the river without ravines, and this is therefore almost the only site strategically placed with reference both to Lucknow and to Mahrattas, and also with good local relations to the Ganges waterway. In contrast with most of the riverside towns of the United Provinces (except Lucknow), the close-built city lies away from the river; this is because the water front was occupied by the cantonment and the East India Company establishments (Fig. 6). The cantonments now lie to the south-east and, with the railway, check expansion in this direction. Expansion has been in the form of tentacles along roads and railways, a constant accretion westward from the boundary of the old riverside cantonment, and the result

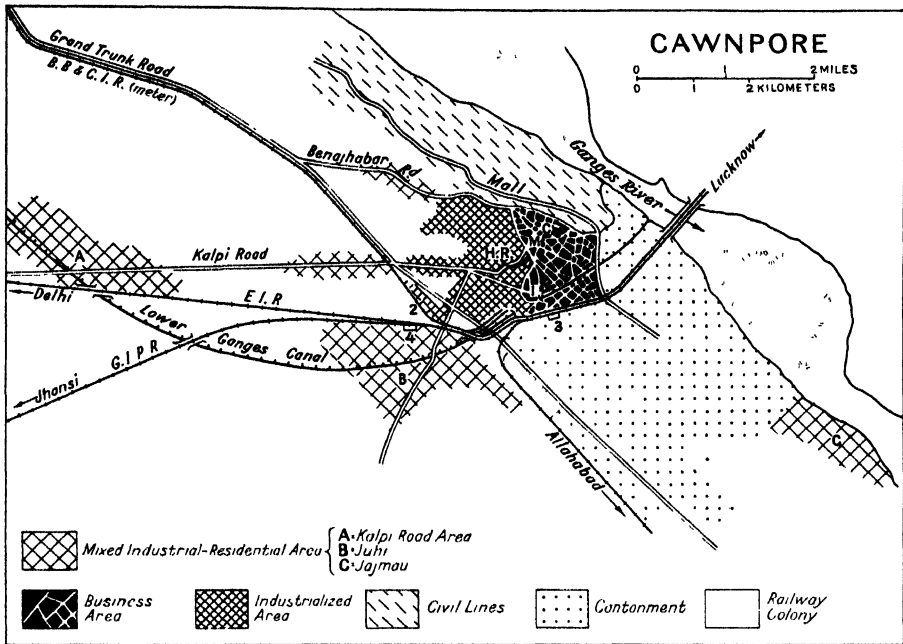


FIG. 6—Key: 1, Collectorganj; 2, Anwarganj Railway Station; 3, Cawnpore Central Railway Station; 4, Juhi Railway Station, C, Chauk; H.R., Halsey Road; M, Mouleganj

of this unplanned growth is seen in "the irregular form of the city, which is a mere congeries of houses, arranged on no definite plan and separated from one another by narrow irregular lanes." Recent reconstruction, confined mainly to the metaling and broadening of main streets and the building of modern shops and houses, has hardly altered the original street "pattern" and may indeed, as not infrequently happens in Indian town improvements, actually have accentuated congestion and slums.¹⁰ In the civil lines and the cantonment the streets, though broad and regular, do not follow any plan except a rough parallelism with the river. Only the railroad colony has, as usual, a mechanically rectangular layout.

The civil lines occupy a strip some four miles long between the Ganges and the Mall, the main thoroughfare of Cawnpore. Like all other civil lines, they are spaciouly laid out, with bungalows of officials and well-to-do citizens, public buildings, offices, and modern shops near the city proper. But, in conformity with the spirit of the place, this is also an important industrial area. Some of the older leather, cotton, and woolen mills are on the river front. Slums, however, have not been allowed to grow; the work-

¹⁰ Cf. Sir Patrick Geddes: *Patrick Geddes in India*, edited by Jacqueline Tyrwhitt, London, 1947, pp. 40-59.

ers reside elsewhere, some in modern quarters to the northwest. The civil lines are succeeded by the cantonment, between the Grand Trunk Road and the river. Buildings are concentrated in the northwestern half of this large area; the rest is occupied by a few villages; and it has all the characteristic monotony of the military landscape, in which even the churches seem to stand at attention. Beyond is the downriver suburb of Jajmau, with a number of tanneries.

The business core (which is also, as usual, largely residential) occupies about a square mile between the Mall and the great grain market of Collectorganj; the ward names, ending in *-bazar*, *-mandi*, or *-ganj* (all signifying "market"), attest its character. Farther west lies the main industrial zone, a great mass of cotton mills, presses, ginneries, and godowns, sugar refineries, tanneries and leather factories, and industrial housing, if "housing" it can be called. Since 1942 there has been a great extension (largely of ordnance and metal works) along the Kalpi road; this area slopes away from the high Ganges bank into the valley of the Pandu Nullah and is liable to flooding in the rains.

Cawnpore's industrial hegemony in the province can best be shown in tabular form:

UNITED PROVINCES				CAWNPORE			
FACTORIES	WORKERS			FACTORIES	WORKERS		% OF U.P. WORKERS
	Total	Average			Total	Average	
1941	670	230,859	344	129	82,732	641	35
1946	959	275,413	287	177	116,198	656	42

Sources: "Large Industrial Establishments in India, 1942," Delhi, 1946; *Labour Bulletin (U.P.)* No. 3, Cawnpore, 1946, pp. 76-95.

In 1931 the percentage of the city's population engaged in both factory and nonfactory industries was 14.3; in 1941 the factory population alone was 17 per cent of the total. In textiles, in 1941, Cawnpore had 62 per cent of the factory workers of the province, in tanning and leather trades 89 per cent. The city is also one of the most important flour-milling centers, and the war brought new ordnance works and aircraft fitting and repair shops. The industrial growth of Cawnpore has attracted large numbers of landless laborers and of agriculturists unable to make a living on their meager holdings, especially from the eastern United Provinces. These are largely a floating population, but there is also a true proletariat here, and in many cases living conditions are probably little better than in the first boom days. It is not surprising that Cawnpore has been noted for the bitterness of its labor disputes.

The initial industrialization of Cawnpore was associated with its commercial functions. By the middle of the nineteenth century it had become a great collecting center for grain, hides and skins, country cloth, and raw cotton; hence the early development of textile industries. The location of the tanning and leather industry is also associated with Cawnpore's importance as a cantonment town with an arsenal and an ordnance depot: as the supply of army leather goods "was obtained solely from the bazars, there soon sprang up a large native industry in boots, harness and accoutrements. . . . All the saddlery and the like required for the Company's forces was obtained from Cawnpore contractors." As at Agra, the presence of a large number of Chamars was also contributory. One Cawnpore firm has the largest self-contained boot and shoe factory in the world.

Today the commercial function of Cawnpore is second to the industrial. A large collecting center for grain and cotton, in hides it is second only to Calcutta, its markets handling some nine thousand daily. As a distributing center it supplies most of the United Provinces with cloth, and Rajputana and the southwestern United Provinces with Nepal rice; its leather goods have an all-India market. Of the five cities, only Benares equals Cawnpore in the number—thirteen—of important banking offices (Lucknow, 10; Allahabad, 9; and Agra, 8). On the other hand, Cawnpore probably stands lowest of the five in administrative, cultural, and educational significance.

THE URBAN LANDSCAPE

This survey of the five cities brings out some common features of the Indian urban landscape. Essentially these spring from the juxtaposition of the overcrowded and irregular or even amorphous Indian city of trades and handicrafts and the more spacious and often mechanically laid-out Anglicized civil lines, cantonments, and railway colony, part of the Indian scene but alien to it. The sharpness of the cultural divide is striking, especially where a railroad belt interposes; there can be no doubt as to which is "the wrong side of the tracks." Occasionally, where the business core and the civil lines abut, there is a transitional zone. The main thoroughfare (generally "The Mall") of the civil lines becomes rather more close-built, with some public buildings and offices, banks, and branches of European firms; shops appear, and second-class cafés and bars frequented by both Indians and Europeans. In the Chauk the adjoining streets are wider than usual, the façades are modernistic (if hardly modern), with a lavish display of colored concrete, and there is probably a clock tower, and perhaps a statue or two of doubtful political tact and esthetic quality. For the rest the heart of the Indian city is

a maze of narrow streets made narrower by the encroachment of open shop fronts and booths, the blocks of buildings traversed by narrow back lanes, unspeakably fetid, serving for the collection of refuse. Outward from the business center, streets degenerate into ill-kept lanes and alleys. The outer fringe is usually revolting, a chaos of mud or matting huts, market gardens, stables, cowsheds, muddy ponds, and waste ground, the dusty breeding place of clouds of flies, the haunt of snakes and scorpions and half-starved cattle.

The civil lines have a distinctive but monotonous aspect: broad roads shaded by flowering trees, large gardens, Western-style bungalows adapted to the climate by the omission of chimneys and the addition of verandas and of a carriage porch, necessary in the rains. The sky line is in general flattish, broken only rarely by a church spire or a government building. In some cantonments, by a perversion of bureaucracy, the very trees carry an official number. In contrast the Indian town bears the marks of a longer, often checkered, history. As yet there has been little sign of the central depopulation that is so marked in large Western cities, and industrial, commercial, and residential functions are much more intermingled than in the West. It is true that modern factories are usually on the outskirts, but a great deal of the minor merchandise for the bazaars is still produced by artisans in their own homes, and, except in the more modernized sections of the business core, even many of the richer merchants continue to combine offices and shops with a residence. The sky line of the old town is broken by mosques and temples, and increasingly by great fortresslike blocks of flats. In the streets the old and the new, the bullock cart and the motorcar, jostle each other; a few yards down the lane from a garish cinema one may find oneself in a medieval setting.

The fragmentary remains of older cultures, the partial superimposition of modern technology, the gross economic inequalities, of the Indian town combine to produce a complex mosaic of ill-assorted elements, never static, always swarming with life. Between the squalor and intimacy of the teeming Indian city and the unimaginative order and aloofness of the wide-spreading, loosely filled suburbias it is sometimes difficult to make a choice. In some measure the Anglicized quarter (most of its inhabitants are Indians) merely reflects the superimposition of a new official caste. East and West live side by side, but there has been no marriage of cultures.

TAKING STOCK IN INDIA AND PAKISTAN

A REVIEW*

O. H. K. SPATE

THE creation of two independent states from the old Indian Empire is naturally an occasion for national stocktaking, and in one way or another this is the theme of all the books discussed in this review except the last. Appropriately enough, the first is a stocktaking of Indian¹ geography itself: a very young subject, still deplorably low in university standing, fighting its way against academic vested interests and intolerance stronger than any known in the West. The wonder is not that immaturity is writ large over much Indian geographical literature but that real progress is being made; the books under review, taken together, represent a substantial contribution.

It is fitting that Mr. Srivastava's survey should appear under the auspices of the Indian Geographical Society, the premier existing geographical society in India if we take into account its protohistory as the Madras Geographical Association, founded in 1926. The issues of the *Journal of the Madras Geographical Association*, until its transformation into the *Indian Geographical Journal* in 1941, show all too clearly the heterogeneity and extreme inequality of geographical work in India as recently as 15 years ago—a few scholarly papers half smothered in a chaos of slipshod and sometimes frankly ludicrous notes on any subject that might minister to local interest. Yet "it would seem less old-fashioned now had it been less effective then," and geography in India owes much to such men as the late N. Subrahmanyam, the leading spirit in the early days of the Madras society—men often practically self-taught as geographers, owing their initial interest to the demands of routine teaching, and retaining it in the depressing atmosphere of the general run of Indian high schools. Frequently naïve and perhaps with a streak of absurd but engaging vanity, they were yet in the forefront when

*Kedar Nath Srivastava: Report of the "Progress of Geographical Education in Indian Universities" (Degree and Post-Graduate Instruction), 1944. Edited by George Kuriyan. 30 pp. *Indian Geogr. Soc. Monograph No. 2*. The Indian Geographical Society, Madras, 1946. Rs. 1 8.0.

Nafis Ahmad: *The Basis of Pakistan*. xi, viii, and 203 pp. Thacker, Spink & Co., Calcutta, 1947. Rs. 7.8.0.

Maneck B. Pithawalla: *An Introduction to Karachi: Its Environs and Hinterland*. xvi and 123 pp. The Times Press, Karachi, 1949. Rs. 5.0.0.

Maneck B. Pithawalla: *An Introduction to Pakistan: Its Resources and Potentialities*. iv and 100 pp. Karachi, 1948. Rs. 5.0.0.

P. C. Chakravarti: *Economic Geography of West Bengal*. viii and 42 pp. City College, Calcutta, 1949. Rs. 2.8.0.

S. P. Chatterjee: *Bengal in Maps: A Geographical Analysis of Resource Distribution in West Bengal and Eastern Pakistan*. viii and 105 pp. Orient Longmans, Bombay, Calcutta, Madras, 1949. Rs. 18.0.0.

S. C. Bose: *The Damodar Valley Project*. iii and 139 pp. Phoenix Press Ltd., Calcutta, 1948. Rs. 4.0.0.

C. D. Deshpande: *Western India: A Regional Geography with Special Reference to Gujarat, Maharashtra and Karnatak*. vi and 276 pp. Students' Own Book Depot, Dharwar (Bombay Province), 1948.

P. J. Thomas: *India's Basic Industries*. xi and 364 pp. Orient Longmans, Calcutta, Bombay, Madras, 1948. Rs. 16.0.0.

C. Collin Davies: *An Historical Atlas of the Indian Peninsula*. 96 pp. Geoffrey Cumberlege (Oxford University Press, Indian Branch), 1949. Rs. 3.8.0.

¹ The usual wearisome disclaimer must be made: "India(n)," unless qualified, either refers to the old undivided Indian Empire or is a mere geographical expression, with no disrespect to Pakistan intended.

it came to the grueling task of putting the subject on the educational map. Progress in the universities was very late and very slow; the credit of the pioneer goes to the Muslim University at Aligarh, most appropriately in view of the past contribution of Islam, but even here degree and research work did not begin until 1929-1930.² A great impetus was given by the recognition of geography as a section of the Indian Science Congress in 1938 and the visit of a strong contingent of British geographers to its Silver Jubilee Session in that year. The last ten years have seen remarkable quantitative advances, and, although quality is still uneven, there are now several universities with good Honours Schools; perhaps the most notable are—in alphabetical order!—Aligarh, Calcutta, Lahore, and Madras. The tendency for the best graduates to take their doctorates in a British or other foreign university is declining. This is natural and on the whole proper; the gain in experience from residence abroad must be balanced against the loss of freshness and firsthand field work. It could be wished, for the sake both of the East and of the West, that a two-way traffic in graduate researchers were feasible. There are now at least four important geographical periodicals: the *Indian Geographical Journal*, edited by Dr. George Kuriyan, the *Calcutta Geographical Review*, the *Panjab Geographical Review* (Lahore), and *The Geographer* (Aligarh). These are backed by a number of societies, which range from the useful to the unmentionable; the latest recruit is the Karachi Geographical Society, under the zealous direction of Professor M. B. Pithawalla.

In spite of all this, much of Mr. Srivastava's review makes sad reading. Nearly everywhere there is a shocking contrast between the proud full sail of the syllabus and the sordid meagerness of the library. The vicious system of "higher" degrees in geography that can be taken by candidates with negligible previous training is not yet dead. Several universities still make only derisory provision for geography; there are very few full chairs, and even Madras has only recently acquired an Honours School and a Rotation Professorship. In these circumstances the competence and energy shown by geography staffs, on the whole, are worthy of respect. Mr. Srivastava's positive proposals are not happy. They amount to a plea for active state encouragement, but with a much too bureaucratic organization, and with more than a hint of a geographers' imperialism of territorial rights in research areas. This solution is obviously influenced by the current atmosphere of planning in all directions. On the larger national scale, as on the smaller academic one, this contagion has its obvious dangers; nevertheless, the great development schemes will clearly call for men trained to grasp the interrelations of the more specialized technologies, and in this lies a great opportunity for the geographers of India and Pakistan. The partition itself raises many essentially geographical problems, and to these we now turn.

Nafis Ahmad's "The Basis of Pakistan" was published before partition and is therefore outdated in parts. Nevertheless, it demands attention as the only full-scale attempt to evaluate geographically the essentially geographical fabric of Pakistan; "El Hamza's" "Pakistan: A Nation" (1941), though not without real geographical spirit, was avowedly slighter and more "political." Professor Ahmad of course has to deal in politics; he gets to the heart of communalism with the simple remark (p. 29) that religious faith in India is "a factor determining an individual's opportunities in society." The political discussions are moderate in

² Rangoon, until 1937 in India, would dispute priority: Professor L. Dudley Stamp's first chair dates back to 1923. Although the university has been desperately hard hit by war and civil disturbance (the campus was used as an artillery emplacement during the Insein fighting last year) it still carries on. In Ceylon also, geography has had full recognition from the start of the university in 1942.

tone; the historical analysis of the differing evolutions of Hindu and Muslim nationalism is clear and on the whole sound. The more purely geographical chapters contain much interesting detail but have suffered most from the changes of 1947. The writer is more modest (because better informed) than many Pakistanis on industrial potentialities, but even so he is probably unduly optimistic. The comparison, for example, of the geological neglect of Western Pakistan with the intensive exploration in the Soviet Union (pp. 69-70) ignores the weakness in economic and industrial physiography of a unit made up mainly of alluvial plains and arid Tertiary ranges. However, it is interesting to note that the development envisaged is, essentially, that of industries based directly on agriculture or ancillary to it; and although the position of Kashmir as a state not then committed either to India or to Pakistan is scrupulously respected, Professor Ahmad clearly thinks that much proposed development in the Punjab depends on the strip of submontane Kashmir. On both these points he is undoubtedly correct. Despite its date, then, "The Basis of Pakistan" is still of value; Professor Ahmad's last chapter is "The Shape of Things to Come"—it would be interesting to have his judgment on the shape that has actually come.

Professor Ahmad hails from Dacca; from Karachi the veteran Professor Pithawalla has thrown himself with more than youthful zeal into the "projection" of Pakistan, and especially of the rather provincial (and in 1941 mainly non-Muslim) town that is the capital of the new state. "An Introduction to Karachi" is by no means only a summary of the larger "Geology and Geography of Karachi and Its Neighbourhood" that Professor Pithawalla (in collaboration with P. Martin-Kaye) produced in 1946; nor is it, happily, the mere guidebook it purports to be. Herr Baedeker, indeed, would die of inanition in Karachi; the geographer and the hydraulic engineer would find much of interest, but the ordinary visitor could hardly be expected to muster up much enthusiasm for the few, and generally jejune, "sights." However, as Pithawalla remarks, if there is too little history, there is more than enough geography, and he is fortunately not content simply to take us around the places of interest, most of which are very recent commercial, official, or transport buildings. It is true that bazaars, students' hostels, and the like are sedulously listed; but the real interest of the book lies in the last three chapters, which deal with the planning of Greater Karachi and its relations with the province and the country. The cultural landscape of the new capital is changing rapidly, and Professor Pithawalla's remarks on this subject are stimulating and sensible. Altogether this is perhaps his best book since his earlier Sind monographs.

As for "An Introduction to Pakistan," the curious reader will find much of interest and some useful details, though he may note with mild surprise that Professor Pithawalla twice (pp. 45 and 84) seems to recommend a revival of the flint-implement industry, and may doubt whether glaciers really "flow down" the arid valleys of the northwestern hills (p. 32A). The vivid description of Bengal (p. 29) may speak for the book: the "Sundarbans . . . are a mountain of morasses and swampy islands, separated by estuaries and tidal creeks. . . . Unlike, again, the Indus delta, Bengal . . . is one of the most thickly populated parts of the world. . . . There are more swamps and waste-lands than cultivable fields in the Province. . . . Human habitations are few and far between."

More conducive, perhaps, to an understanding of Bengal are some Calcutta publications. Of these, Professor Chakravarti's "Economic Geography of West Bengal" is stocktaking of a sort that would spell disaster if accepted as accurate. The shocking English would not matter if it were not that the economics are on the same plane. The statistics are careless:

on page vi, for example, we find that the area under potatoes is about the same as that under rice, and 90 times that under wheat. Professor Chakravarti seems to think that *all* the "culturable waste" can be planted to rice—a theory exploded by the Royal Commission on Agriculture in India as long ago as 1928—and that if this were done, yields on these marginal, largely lateritic, lands would be precisely equal to those in existing paddy fields. The book is notable as an example of one obstacle Indian geographers have to face—the proliferation of shoddy work under a more or less academic or official imprimatur.

What Professor Chakravarti fails to do for West Bengal, Dr. Chatterjee's "Bengal in Maps" carries out with complete success for both East and West. The subtitle inadequately describes the content of the 80 maps, mostly distribution maps on the scale of 52 or 104 miles to the inch. There can be few aspects of the geography of Bengal that are not represented; quite properly, population and agriculture receive most attention. Great care has been taken, by the use of two methods or more, to avoid misleading representation of such matters as religious distributions; the accompanying text is admirably concise and objective—the "culturable waste," for example, is clearly analyzed. Both in content and in graphic presentation, "Bengal in Maps" ranks high among Indian geographical publications. Professor S. C. Bose's "The Damodar Valley Project" is less ambitious, but on its slighter scale it is also a useful contribution. It is indeed rather a regional analysis of the basin than a description of the project itself; only the last chapter, some 20 pages, deals specifically with current developments on the Damodar and it is perhaps a little disappointing. However, useful points on the scheme are scattered through the rest of the book, and the regional chapters are clear and vivid, giving an excellent picture of both the physical and the cultural landscapes. Special mention may be made of the interesting chapters on the physiography below the Damodar elbow and the excellent population and settlement maps of the lower part of the basin.

But as a regional study Mr. C. D. Deshpande's "Western India" is more important in that it breaks new ground. Aside from Pithawalla's works on Sind—a rather less complex case—previous regional publications have been few, and far more restricted in scope.³ "Western India" is simply the present Bombay Province (including the recently merged states) and Saurashtra, the union of states occupying Kathiawar. This area, though hardly homogeneous, certainly has a high degree of individuality and is a reasonable unit of study. But Mr. Deshpande does not really make clear his case for considering it a "region," contrasted with other provinces, and one is left with the feeling that he himself is not quite satisfied with his argument. Maharashtra, in a way the core of the "region," admittedly extends well beyond the limits of the study, into the Central Provinces and Hyderabad. There is a good enough empirical case for taking the arbitrary political boundary as a limit, but it has been confused with an unreal "regional" issue. This general criticism once made, there can be little but praise for the rest. Western India is divided into regions comparable with those used, say, in France or Britain—a great refinement on the broad general divisions used perforce in general works on Asia, which, it is sobering to reflect, are really the only modern geographies of India in existence. The regional treatment is at once full and selective; Mr. Deshpande handles his sources well and does not fall into the gazetteer trap, a constant peril to Indian geographers. Probably no other country has anything like this Domesday of

³ It is significant that the three outstanding regional studies (exclusive of unpublished theses) were all published in Paris: Arthur Geddes: *Au pays de Tagore* [1927?]; S. P. Chatterjee: *Le plateau de Meghalaya*, 1936; M. H. Rahman: *L'Oudh*, 1940.

topographical, historical, economic, social, and statistical information, district by district—592 volumes in all. Despite their age (40 to 60 years) and their extreme inequality, they contain enormous masses of information available nowhere else, and with the added advantage of a standard layout. But the possession of this treasure has too frequently favored the mere compilation of lists, and a reluctance to go and see for oneself, since "it's all in the Gazetteer." Mr. Deshpande uses this source fully, but he has also seen much for himself, and his descriptions are full of interesting detail, both physical and human; the essential, and fascinating, historical and cultural element is likewise well depicted. There are many maps, most of them reasonably good, though they are (especially the keys) too greatly reduced. In short, this is the first true large-scale regional monograph, alike signposting some of the innumerable research problems and providing one of the units from which a regional geography of the whole subcontinent can be built up. More monographs of this kind are urgently needed; it is to be hoped, also, that future editions of "Western India" will be called for, and that they will eliminate some of the 500 or so misprints, of which 40 are included in the list of errata! Annoying as these are, they should not be allowed to detract from our appreciation of a notable piece of work.

For those who are not specialists in Indian regional geography, Dr. Thomas' book on basic industries is perhaps the most important on the list—a detailed factual survey, industry by industry, based on reports prepared, for the most part, for India's wartime Supply Department. These have been arranged in a fairly logical order and grouping, such as minerals, power, engineering; but the sections, and the chapters within them, though individually good have little interconnection. The value of the book would have been greatly increased by the inclusion of a more general discussion of problems and potentialities. Such discussion is confined to two or three unrevealing pages in the preface and a very short chapter on the need for research. Dr. Thomas' style, aside from occasional lapses, is reasonably concise and clear, but repulsively arid; "India's Basic Industries" is tedious reading, and probably only reviewers afflicted with conscience will plow right through it.

From the mass of facts some generalities emerge. Perhaps the most striking motifs are the enormous expansionist effect of the past war and (not altogether by the author's design) the contrast between the often rudimentary scale and organization of production and the astonishingly rapid progress made in certain lines. This of course means that industry in India is far from being an integrated whole; it works, as it were, by fits and starts. On the one hand, the general backwardness is illustrated by such facts as the following: of the 725 coal mines in active operation in 1942, 133 produced less than 1000 tons (p. 77); more than 50 per cent of the electrical energy generated in India is used in four towns (Bombay, Calcutta, Cawnpore, Ahmedabad) that contained less than $1\frac{1}{2}$ per cent of the 1941 population, the total production (thermal and hydro) in 1943 equaling about one week of United States output (pp. 134-135 and 142); the prewar ammonium sulphate consumption was only 90,000 tons a year, more than half of it on plantations (p. 263); the per capita consumption of edible oils in 1944 was only about five pounds, and this in one of the world's largest producers of oilseeds (p. 285); of the 59 glass factories in 1932, 26 were engaged solely in producing bangles (p. 330)—not exactly a basic industry! On the other hand, steel production nearly doubled during the war (p. 16), and the Jamshedpur works are the largest in the British Commonwealth (p. 15); an Indian-built floating dock is said to be the largest in the world (p. 165); the Army demand for boots rose from 100,000 pairs a year before the war to

6,600,000 in 1943 (p. 305). As Dr. Thomas remarks, with an understatement positively British and most un-Indian, "this involved a sudden expansion of the industry," and one Cawnpore firm has now the world's largest self-contained footwear factory.

Here, in a sense, is God's plenty for the economic geographer; and yet, because of the essentially compilatory approach, the book fails to make the impression it might have done. The lack of a general diagnosis is the more unfortunate in that Dr. Thomas is exceptionally well fitted, by training and by the opportunities of his official career, to make a well-balanced appraisal of the industrial situation in India. He is far indeed from sharing the common Indian fallacy that if you have, for example, large supplies of sour grapes, all that is needed is an All-India College of Grape Technology, and forthwith Bordeaux and Oporto will close their doors. The economic climate of India and the world, factors of the market and of integration, are always present to his mind; he is optimistic, but not beyond the physical and economic facts. This, despite its dry monotony of style, makes "India's Basic Industries" a refreshing change from the harebrained "planning" popular among Indian publicists, some of whom seem to think that the sacred syllables "hydroelectricity" if repeated often enough will of themselves cause the desert to blossom like the rose. As a reference book on the condition of Indian industry immediately after the war, and a pointer to the most needed and the most likely lines of advance (not always the same lines), Dr. Thomas' book is invaluable, and one can only regret the absence of a broader treatment and the fact that, except for a sketchy addendum of half a dozen pages, it virtually stops short in 1945.

Neither Dr. Thomas nor Dr. Davies is a geographer, and the latter is the only non-Indian or non-Pakistani author on our list. He shows more awareness of the need for a geographical approach than Dr. Thomas. "India's Basic Industries" is the most comprehensive stocktaking before us; but it is as well to be reminded that the new India springs from the old, and any appraisal of the life of the subcontinent will be rootless if it neglects the old India of immemorial religious cultures, of fantastic dynasties, of hundreds of thousands of village republics, a mosaic of peoples among whom all stages of human organization (except Soviet Communism) exist side by side, a paradise for the economic no less than the cultural historian. "An Historical Atlas of the Indian Peninsula" provides an outline of the history in 48 maps and brief accompanying notes. The idea is not so new as Dr. Davies seems to think—there are one or two similar atlases on the market—but the execution is certainly much superior to anything existing. The black-and-white maps are clear, if not very imaginative in technique; the text, of course, is simply a synopsis, but it often penetrates a surprising depth into the rationale of events. Dr. Davies' old interest in the North-West Frontier has ensured that the landward links are fully treated; but, unlike many historians whose gaze is with difficulty averted from the Khyber, he is aware that "the isolation of India from the sea" is in large part mythical, and his map of Hindu expansion into Indonesia and Indochina well displays that less familiar story.

Most of the books reviewed here show some signs of immaturity, and one or two are definitely misbegotten. Indian geography is still young, but there is already ample promise and fair achievement. Nevertheless, the "culturable waste" far exceeds the tilled area; there are rich rewards for the pioneers. It is hardly an exaggeration to say that large tracts, especially in the backward areas between the Son and the Mahanadi, are virtually terra incognita to modern geography. Everywhere the subcontinent abounds in fascinating, but completely untouched, problems—geomorphological, human, historical. Most of the books reviewed in these pages are encouraging tokens of the spirit in which this immense agenda will be tackled.

CONTRIBUTIONS TO GEOGRAPHICAL KNOWLEDGE OF CANADA SINCE 1945

ANDREW H. CLARK

IN THE past few years publications concerned with Canada have appeared in great volume. Even a moderately comprehensive review of those of interest to geographers requires a high degree of selectivity and the arbitrary exclusion of whole categories that might logically seem to demand mention. The emphasis of the present survey is on writings by Canadians about their own country, and particularly the published work of professional geographers, though this still leaves most of the discussion to contributions by students in other fields. Since it was felt that the work of the new school of French-Canadian geographers might be overshadowed, its products, with a very few exceptions, are reserved for analysis on a later occasion.

THE SOURCES

In general, official government publications are not included; it is assumed that students of Canadian geography are aware of the constant flow of material from the federal and provincial government departments, and, in particular, from such agencies as the Dominion Museum, the Geological Survey, the Hydrographic and Map Service, the Meteorological Service, and the Dominion Bureau of Statistics. Data from these agencies are basic departure points for much geographical work.

The periodical sources are many and varied. Of the principal ones, the *Canadian Geographical Journal* offers a popular exposition comparable with that of the *British Geographical Magazine*, and some of the articles are of genuine scientific and scholarly interest. Important to geographers in general are the *Canadian Historical Review*, the *Canadian Journal of Economics and Political Science*, *L'Actualité Économique*, *Scientific Agriculture*, and the *Agricultural Institute Review*.

At the outset it is well to note the relative lack of interest in physical geography on the part of the professional geographers of Canada. Research work in this field has been almost entirely sponsored and directed by government agencies. The corporal's guard that represents geography under its own name, in the government itself and in a very few colleges and universities, has been primarily concerned with what might be termed "human" or "cultural" geography, particularly in relation to activities of economic interest. Engaged in a serious struggle for recognition or, indeed, actual survival, this group has directed its efforts chiefly toward immediate economic, political, military, or elementary educational advantage to the community rather than to the general advancement of knowledge and scholarship. It must be remembered, too, that the first university department of geography was created only in 1935, four years before the outbreak of the war.

Because he is an enthusiastic and unabashed publicist for the theories and methods he believes important, Professor Griffith Taylor of the University of Toronto, occupant of that

► DR. CLARK, a Canadian by birth, is professor of geography and chairman of the Department of Geography at Rutgers University, New Brunswick, N. J. He received part of his graduate training in Canada and has since maintained an active interest in its geography.

first chair in geography,¹ is an outstanding exception to the tendency toward encyclopedism and lack of creative work manifested by professional geographers in Canada in general. Through his energy and promotional ability he has developed at Toronto in 15 years one of the largest departments of geography on the North American continent. Yet Taylor's unceasing spate of writings and pronouncements has perhaps only served to drive other Canadian geographers farther into their encyclopedic foxholes; indeed, his originality and independence have been main targets of attack. To one who knows and respects both Taylor and his principal critics, this attitude seems to have done grave harm to the development of geographical study in Canada, and to be an unfortunate reflection alike on the object of the criticism and on those who make it; yet reasons for it are not hard to find.

The chief movement toward breaking new intellectual ground and winning wider scholarly and scientific respect for geography in Canada has appeared in the Department of Geography at McGill, established in 1946 by Professor George H. T. Kimble.² A department of similar scope has been set up at the University of Montreal and smaller departments at the University of Western Ontario and McMaster University, and the work in geography in a joint department with geology at the University of British Columbia has advanced almost to the status of a separate entity. Otherwise, university instruction in geography, aside from the training of teachers in colleges of education, either is limited to the efforts of one man, as in the University of Manitoba, or is completely absent, as in all the Canadian colleges and universities east of Quebec, in Queen's University, and in the Universities of Saskatchewan and Alberta.

A new center of geographical research separate from the universities has appeared since the war in a Geographical Bureau within the Department of Mines and Resources at Ottawa. Currently it is employing nine full-time geographers under the direction of Dr. J. Wreford Watson, on leave from his duties as chairman of the department at McMaster. In addition to these there are probably fewer than forty professional geographers, recognized as such, engaged in teaching and research in Canada.

REGIONAL STUDIES

CANADA AS A WHOLE

Taylor's "Canada"³ represents the summary of a decade of his thinking, studying, and writing about Canada. The book was completed in 1945 before the end of the war, and its statistical basis is largely that of the 1930's. It has been widely reviewed and even more widely discussed. Professor Kimble, writing in the *Geographical Journal*, is critical of carelessness in detail and of deviation from accepted standards of logical conclusion from evidence presented. The maps, mostly of the sketchy, freehand type that a well-known geographer once appropriately tagged "Taylor-made," have also been accorded the rough treatment given

¹ In the tradition of Old France, Laval University of Quebec offered work in geography, associated with history, some time before the establishment of the department in Toronto. There was also work in geography in several teachers colleges; and various university departments of economics, history, and geology had for some time offered courses entitled, or subtitled, "geography."

² Director Designate of the American Geographical Society. See the *Geogr. Rev.*, Vol. 40, 1950, pp. 1-3.—EDIT. NOTE.

³ Griffith Taylor: *Canada: A Study of Cool Continental Environments and Their Effect on British and French Settlement*. xv and 524 pp. [Methuen's Advanced Geographies.] Methuen & Co., London, 1947. 25s. Reviewed by G. H. T. Kimble, *Geogr. Journ.*, Vol. 111, 1948, pp. 108-111.

similar illustrations in critical reviews of many of his earlier works. The maps do indeed present a problem in analysis and description. Perhaps one-fourth of them are carefully done, with skill and imagination successfully conveying essentially accurate information to the reader. The rest, which grade off to almost illegible palimpsests with every conceivable kind of information or hypothesis crowded carelessly into a small space, hurt, rather than help, the purpose of the book. The apparent belief that a map, cartogram, or diagram is a worthy thing in itself thus neutralizes the effect of the good diagrams. The profession has long known Professor Taylor as a self-confessed environmental determinist. It has long known him also as a prolific inventor of terminology that often approaches esoteric jargon. Above all it knows him as an individualist who presents dozens of theories and rides these theories relentlessly. If these things are taken for granted and the reader makes up his mind to let neither them nor the "Taylor-made" cartograms annoy him, he should profit greatly from a careful study of both the book and the diagrams themselves.

On page 3, for example, there is a fine comparison and contrast of Canadian and European climates. The discussion of the basic geology and geomorphology, which the author usually lumps together under the term "build," does open many new and enlightening points of view for anyone who has a fundamental knowledge of the facts on which the discussion is based. If the reader possesses a reasonably good background of Canadian history and is willing to condone such opinions as (p. 15) "the greatest name in early Canadian history is that of Jacques Cartier" (shade of Champlain!), he will be edified by the treatment of early exploration and settlement, if not by the highly individualistic ethnographical theories. For Taylor has himself explored many out-of-the-way parts of the world and brings the view of a participant to his descriptions. The chapter on climates tempts one to quote several sentences with which unsympathetic critics of Taylor's books are wont to enliven their reviews. Yet, on the whole, the discussion of climates is fair in substance and written with the usual verve. The several chapters on economic geography are the best in the book.

Canada is divided into 20 regions ("the experience of the writer in regard to an analogous case—that of Australia—has led him to the conclusion that a total of about twenty such units is advisable" [p. 113]). It is unfortunate that, though the number of divisions and their boundaries are freely admitted by the author to be arbitrary and considerably affected by the human factor, they are nevertheless called "Natural Regions," which would seem to give them a Herbertsonian sanction. The reviewer assents most heartily to the statement that "it is unlikely that any two authors would agree as to the subdivisions to be chosen." There is a cross classification of these "regions," and though few readers would be happy with it, it makes, on the whole, a rather useful framework for a sectional description of Canada. It certainly follows no traditional precedents.

In the concluding chapter Taylor gives free range to his highly individualistic approach to geographical interpretation in a discussion of "Population Problems, Present and Future." His figure for the optimum population of Canada at whatever level is implied in the phrase "on the European standards" is about 100 million, or at the present standard of living, half of that.

An economic study of Canada as a whole is to be found in Alfred J. Wright's "United States and Canada."⁴ It devotes 47 pages to Canada and seven to Newfoundland, Labrador,

⁴ Alfred J. Wright: *United States and Canada: An Economic Geography*. xiv and 490 pp. (The Century Earth Science Series.) Appleton-Century-Crofts, New York and London, 1948. \$4.50.

and Greenland. The treatment is, perforce, almost purely descriptive, the maps are extremely sketchy and statistical tables few, yet the writing is mature, and the section is a minor masterpiece of condensation. The weaknesses perhaps inevitable in such summary treatment are more strikingly evident in Currie's "Economic Geography of Canada,"⁵ which should certainly have had a much more useful and comprehensive statistical and cartographic illustration. The too elaborate treatment of physical geography is neither competently done nor justified by the sketchy utilization made of it in later analysis. However, the interpretation and description of geographical problems of transportation are recommended as an important contribution.

Among recent school texts is "Canada and Her Neighbours" by Professor Taylor and two associates⁶—a particularly good job, with excellent maps and photographs and a well-written, lucid text.

In September, 1947, The American Academy of Political and Social Science devoted its *Annals* to "Features of Present-Day Canada," in which 26 authors, in an average of roughly eight pages apiece, discussed various aspects of the Canadian scene. Those of special interest to geographers will be noted below.

NEWFOUNDLAND AND LABRADOR

In the past few years Newfoundland and Labrador have received considerable attention, because of the question of union, effected in 1949, their strategic position, and the preliminary development of the great iron-ore deposits on the Quebec-Labrador border. Contributions by Griffith Taylor and a group of scholars headed by Professor R. A. MacKay of Dalhousie University have already been noted in the *Geographical Review*.⁷ Taylor's brief pamphlet is in the style of his book on Canada (see p. 286 above), with the usual complement of sketches. The MacKay volume is by a good margin the most useful scholarly work to become available to serious students of Newfoundland in recent years. The physical geography is given an eight-page summary, but it is an excellent summary, and the inescapable implications of the limitations of the physical environment, and of Newfoundland's strategic position in the North Atlantic, are constantly referred to in other sections of the book. The narrow range of the island's staple export economy and the peripheral location of its 300,000 people also receive close attention. One of the contributors to this volume, Professor A. M. Fraser of St. John's, has recently added a postscript in an article entitled "Newfoundland's Contribution

⁵ A. W. Currie: *Economic Geography of Canada*. xiv and 455 pp. The Macmillan Company of Canada Limited, Toronto, 1945. \$3.50.

⁶ Griffith Taylor, Dorothy J. Seiveright, and Trevor Lloyd: *Canada and Her Neighbours*. viii and 248 pp. Ginn & Co., Toronto, 1947. \$2.50.

Similar in aim, but less successful in accomplishment, are: Frances Carpenter: *Canada and Her Northern Neighbors*. ix and 438 pp. American Book Co., New York and Toronto, 1946. \$1.40.

Margaret McWilliams: *This New Canada*. xiv and 328 pp. J. M. Dent & Sons (Canada), Toronto and Vancouver, 1948. \$3.75.

Frances Aileen Ross: *The Land and People of Canada*. vii and 128 pp. (Portraits of the Nations Series.) J. B. Lippincott Co., Philadelphia and New York, 1947. \$2.50.

⁷ Vol. 37, 1947, p. 665.

Griffith Taylor: *Newfoundland: A Study of Settlement with Maps and Illustrations*. 34 pp. *Canadian Inst. of Internat. Affairs Special Ser.*, Toronto, 1946.

R. A. MacKay, edit.: *Newfoundland: Economic, Diplomatic, and Strategic Studies*. xiv and 577 pp. Issued under the auspices of the Royal Institute of International Affairs. Oxford University Press, Toronto, 1946.

to Canada,"⁸ stressing strategic value. Improved bargaining power with the United States on civil-aviation rights, a new market, an addition of 50 per cent to the total fish catch, and the iron ore of Labrador are also noted as benefits accruing to Canada as a result of the union.

The *Canadian Geographical Journal* has carried articles concerned with Newfoundland, as usual with excellent photographic reporting.⁹ And *Arctic* and the *Polar Record* have not ignored northern Labrador; J. T. Wilson¹⁰ provides a good summary of its economic potential.

There has also been a flood of technical publications,¹¹ many popular or semipopular books such as "This Is Newfoundland,"¹² and a long series of articles in the newspapers and popular magazines. The late Väinö Tanner's monograph on "Newfoundland-Labrador,"¹³ i.e. the eastern part of the Labrador peninsula, is a valuable source book on physical geography and ethnology.

THE NORTH COUNTRY

The chief focus, however, has been what one of its most avid students, Professor Trevor Lloyd, calls "Canada's Strategic North."¹⁴ Professor J. Lewis Robinson, most prolific of scientifically trained observers writing in the *Canadian Geographical Journal*, published some dozen articles dealing with northern areas between 1944 and 1948.¹⁵ The article on fur production in the Northwest Territories, with charts of fur production and detailed discussions of individual fur bearers, constitutes a particularly valuable addition to general geographical knowledge of the region. Only 10 per cent by value of Canada's fur catch comes from the Northwest Territories, and in only one pelt, white fox, does that region lead the rest of the country. Although the general descriptive articles in the *Journal* do not properly come within the scope of this review, "Tractor Trails in Manitoba" (Vol. 38, 1949, pp. 70-77) by Lyn Harrington, with illustrations by one of Canada's best out-of-door photographers, Richard Harrington, should prove of wide interest to transportation geographers, who have given little attention to tractors as a means of transport in the winters of the roadless Shield.

⁸ *Internatl. Journ.*, Vol. 4, 1949, pp. 250-260.

⁹ For example, G. A. Mercer: Newfoundland, *Canadian Geogr. Journ.*, Vol. 36, 1948, pp. 104-129.

¹⁰ [J. T. Wilson:] The Economic Resources of Labrador, *Polar Record*, Vol. 5, Nos. 35-36, 1948, pp. 155-162.

¹¹ For example, A. W. Templeman: A Brief History of Fisheries Research in Newfoundland, *Canadian Fisherman*, Vol. 32, 1945, pp. 24, 26, 30, and 43.

¹² Ewart Young, edit.: This Is Newfoundland. xii and 105 pp. The Ryerson Press, Toronto, Halifax, Vancouver, 1949. \$4.00.

¹³ V. Tanner: Outlines of the Geography, Life and Customs of Newfoundland-Labrador (The Eastern Part of the Labrador Peninsula). Vol. 1, 436 pp.; Vol. 2, pp. 437-906. *Acta Geographica*, Vol. 8, No. 1, Helsingfors, 1944. (Reviewed by Richard Foster Flint, *Geogr. Rev.*, Vol. 36, 1946, pp. 514-515.) Also published by The Macmillan Company, New York (\$13.50) and Toronto (\$11.00), and the Cambridge University Press, London (50s.), 1947.

¹⁴ Trevor Lloyd: Canada's Strategic North, *Internatl. Journ.*, Vol. 2, 1947, pp. 144-149.

¹⁵ Including: "Land Use Possibilities in Mackenzie District, N.W.T.," Vol. 31, 1945, pp. 30-47, and "Agriculture and Forests of Yukon Territory," *ibid.*, pp. 54-72 (noted in the *Geogr. Rev.*, Vol. 36, 1946, pp. 321-322); "Water Transportation in the Canadian Northwest," *ibid.*, pp. 236-256; "Fur Production in the Northwest Territories" (with M. J. Robinson), Vol. 32, 1946, pp. 34-48; "Weather and Climate of the Northwest Territories," *ibid.*, pp. 124-139; and "Canada's Western Arctic," Vol. 37, 1948, pp. 242-260. A convenient reference for articles on the northern regions published in the *Canadian Geographical Journal* from 1930 to 1947 is found in "A Regional Bibliography" compiled by Professor Robinson for The Canadian Geographical Society (13 pp. 50 cents).

From time to time government officials of standing, such as Dr. Charles Camsell, have written on "The New North" for the *Canadian Geographical Journal* (Vol. 33, 1946, pp. 264-277), in some detail and with real concern for regional analysis. J. Tuzo Wilson's "Winter Manoeuvres in Canada" (Vol. 32, 1946, pp. 88-100) gives a brief description of certain aspects of "Exercise Musk-Ox." Military operations and problems in the region have received notice in other periodicals besides the *Journal*.¹⁶

The *Canadian Journal of Economics and Political Science* published a comprehensive series of articles on the region in 1945 and 1946, which were brought together in one volume in 1947.¹⁷ This same year also saw Lothian's useful pamphlet on the Yukon Territory¹⁸ published by the Department of Mines and Resources. A more summary account of the region and its southwestern fringes appeared in 1947 under the aegis of the North Pacific Planning Project.¹⁹ Of more largely agricultural emphasis is the report of A. G. Dustan on his visit to the Mackenzie Basin.²⁰

Of definitely scientific nature is a series of articles in *Arctic*, which began publication in 1948.²¹ For instance, in its first number R. Glenn Madill in "The Search for the North Magnetic Pole" (pp. 8-18) gives an excellent historical summary of observations of terrestrial magnetism in the Canadian North and an account of those made in the summer of 1947; and Andrew Thomson, dean of Canadian meteorologists, summarizes "The Growth of Meteorological Knowledge of the Canadian Arctic" (pp. 34-43), with a useful catalogue of the types of observations available at different stations and a good map of the observational network.

The *Geographical Journal*, with its marked interest in exploration, has published several articles on northern Canada. D. C. McKinley and K. C. Maclure of the *Aries* aerial expedition, of May, 1945, report on those flights (Vol. 107, 1946, pp. 90-104 and 105-126); Maclure's paper is particularly interesting for his practical comments on the use of the Greenwich grid system of orientation for polar flying. T. H. Manning gives (Vol. 109, 1947, pp. 58-75) geological, geomorphological, and botanical details observed during "Explorations on the East Coast of Hudson Bay" for the purpose of establishing ground-control positions for the Geodetic Service of Canada; and Henry A. Larsen reports on the Arctic voyages of the *St. Roch*, 1940-1944 (Vol. 110, 1947, pp. 1-16).

Of articles on the economic and political significance of northern Canada there has been

¹⁶ For example: P. D. Baird: Snow and Ice Conditions on "Exercise Musk Ox" (Northern Canada), *Journ. of Glaciology*, Vol. 1, No. 2, 1947, pp. 75-76.

Andrew Croft: Travel in Canada's Northland, *Geogr. Mag.*, Vol. 20, 1947-1948, pp. 47-58.

G. W. Rowley: Exercise Muskox, *Geogr. Journ.*, Vol. 109, 1947, pp. 175-185.

J. T. Wilson: Exercise Musk-Ox, 1946, *Polar Record*, Vol. 5, Nos. 33-34, 1947, pp. 14-26.

¹⁷ C. A. Dawson, edit.: *The New North-West*. x and 341 pp. The University of Toronto Press, Toronto, 1947. \$4.25. (See also the note in the *Geogr. Rev.*, Vol. 36, 1946, pp. 320-321.)

¹⁸ W. F. Lothian: *Yukon Territory: A Brief Description of Its History, Administration, Resources and Development*. 52 pp. King's Printer, Ottawa, 1947.

¹⁹ "Canada's New Northwest: A Study of the Present and Future Development of Mackenzie District of the Northwest Territories, Yukon Territory, and the Northern Parts of Alberta and British Columbia." 155 pp. The North Pacific Planning Project [Ottawa], 1947.

²⁰ A. G. Dustan: A Trip into the Mackenzie Basin, *Agric. Inst. Rev.*, Vol. 2, 1947, pp. 12-17. In the same category might be placed H. J. Hargrave: *Arctic Livestock, Country Guide*, Vol. 5, 1948, pp. 61-62.

²¹ See the note in the *Geogr. Rev.*, Vol. 38, 1948, p. 498.

an unending stream since the end of the war. L. B. Pearson's government-oriented attitude toward the national significance of the North and Wilfrid Eggleston's viewpoint of a top-flight economic and political reporter are two of the best examples.²² *Public Affairs*, a dependable source of studies of the Canadian polity and economy, has contributed some useful comments by H. W. Hewetson, with a less technical discussion of climate, agriculture, trapping, and mining.²³

Popular books on the region have been many.²⁴ Finnie's "Canada Moves North," first published in 1942 and revised in 1948, has received wide publicity because of its enthusiasm and optimism regarding the future of the North. The writing and the logic are apt to be confused and unconvincing, but salted in here and there are shrewd observations from a man familiar with the region for two decades. "The English regarded New England as a cold and inhospitable country . . . It is taking much longer for Canadians to realize that the Northwest Territories are no colder, no more inhospitable—in relation to the facilities of modern science—than New England was in the eyes of the people who hadn't yet visited it in the seventeenth century" (p. 1). There are some salutary remarks (though the evidence is often lacking and the documentation is careless) on fur trading and missionary activities in their social implications. The author writes interestingly of the perversion of Christian beliefs and doctrine, which parallels similar developments in many other parts of the world where Christianity has been laid over an existing culture pattern, and of the strong missionary competition between the Roman Catholic Church and the Church of England and its effects.

THE SOUTHERN SETTLED AREAS

This section of the discussion is most hampered by limitations of space, but since this is the classificatory pigeonhole in which the bulk of the work by Canadian professional geographers must be placed, some attention is mandatory. The "provincial geographical aspects booklets" (including one on Newfoundland) published by The Canadian Geographical Society, which appeared first as articles in its *Journal*, are valuable chiefly for the excellent pictorial contributions. Among them Jim Wright's "Saskatchewan" (Vol. 34, 1947, pp. 108-136) deserves special mention as the most satisfactory geographical introduction to Canada's central Prairie Province yet available.

For maritime Canada, F. J. Alcock's "The Isles of Fundy"²⁵ (Deer Island, Campobello, Grand Manan) is a distinct, though brief, addition to general geographical knowledge of the

²² L. B. Pearson: Canada Looks "Down North," *Foreign Affairs*, Vol. 24, 1945-1946, pp. 638-647. Wilfrid Eggleston: Strategy and Wealth in Northern Canada, *Queen's Quart.*, Vol. 54, 1947, pp. 238-249.

²³ H. W. Hewetson: What Are the Possibilities of Settlement in Canada's North Land? *Public Affairs*, Vol. 10, 1946, pp. 20-25. See also a brief note, looking backward rather than forward, by J. A. Glen: A Review of the Development of the Northwest Territories, *Industrial Canada*, May, 1946, pp. 82-85 and 126.

²⁴ A few examples are: Bruce D. Campbell: Where the High Winds Blow. ix and 221 pp. Charles Scribner's Sons, New York, 1946. \$2.75.

Richard Finnie: Canada Moves North. Revised edit. ix and 239 pp. The Macmillan Co., New York, 1948. \$3.75. (The first edition, 1942, was reviewed in the *Geogr. Rev.*, Vol. 32, 1942, pp. 506-507.)

Charles E. Gillham: Raw North. xvi and 275 pp. A. S. Barnes & Co., New York, 1947. \$3.75.

Leslie Roberts: The Mackenzie. xii and 276 pp. (Rivers of America.) Rinehart & Co., New York and Toronto, 1949. \$3.50.

²⁵ *Canadian Geogr. Journ.*, Vol. 39, 1949, pp. 92-107.

area. A new edition of W. F. Ganong's "Ste. Croix (Dochet) Island"²⁶ is welcome to historians and geographers alike.

Professor D. F. Putnam of the University of Toronto and three of his former students have contributed studies of the Ontario region.²⁷ Putnam's methodical analysis of Manitoulin Island is sparing of words and generalizations. L. G. Reeds's article on the Kawartha Lakes area of central Ontario is much more detailed but still shows evidence of overcondensation; however, the classification of land types, emphasizing the significance of drainage and relief, would alone make it a welcome addition to our knowledge of Ontario. For the northern part of the province a study of the James Bay area²⁸ yields some interesting illustrations and basic information.

Aside from Wright's article noted above, the chief contribution on Saskatchewan seems to be R. A. Sturt's discussion of "Land Settlement in Northern Pioneer Areas of Saskatchewan."²⁹ We may hope for some early studies of the new boom areas of northern Alberta. At least three works concerned with British Columbia deserve attention.³⁰ George B. White's lengthy report on the eastern Fraser Valley will find readers among geographers as well as among historians, and a Department of Agriculture bulletin by W. J. Anderson on land settlement in the Prince George area is excellent. Most stimulating is a brief but well-organized analysis of "Settlement Problems in British Columbia" by John Stainer, an Oxford-trained geographer. He starts by criticizing certain references to British Columbia in Taylor's "Canada" but quickly mounts his own hobbyhorse. Essentially he draws attention to influences, past and present, that have led to the development of overcrowded districts separated by broad empty stretches, and he suggests methods of government planning to spread population and industry. He may be a Don Quixote tilting at windmills, but the tilting is done with a flair.

SYSTEMATIC STUDIES

PHYSICAL GEOGRAPHY

Some exceptions to the earlier generalization regarding Canada's professional geographers and physical geography should be noted. Professor J. L. Robinson's contribution on the Canadian western Arctic appeared in the *Canada Year Book* for 1948-1949.³¹ John L. Jenness'

²⁶ William Francis Ganong: *Ste. Croix (Dochet) Island: A Monograph*. Revised and enlarged [2nd edit.] from the author's manuscript notes; edited by Susan Brittain Ganong. xix and 125 pp. *New Brunswick Museum Monographic Ser. No. 3*, Saint John, 1945. This monograph first appeared in the *Proceedings and Transactions of the Royal Society of Canada*, Ser. 2, Vol. 8, 1902, Sect. 2, pp. 127-231.

²⁷ D. F. Putnam: *Manitoulin Island*, *Geogr. Rev.*, Vol. 37, 1947, pp. 649-662.

D. W. Kirk: *Settlement Pattern of the Listowel Region, Southwestern Ontario*, *Econ. Geogr.*, Vol. 23, 1947, pp. 67-71.

L. G. Reeds: *Land Utilization in Central Ontario*, *ibid.*, Vol. 22, 1946, pp. 289-306.

William C. Wonders: *The Penetanguishene Peninsula*, *Canadian Geogr. Journ.*, Vol. 37, 1948, pp. 118-129.

²⁸ Hugh Mackay: *Moose Factory*, *Geogr. Mag.*, Vol. 21, 1948-1949, pp. 273-280.

²⁹ *Agric. Inst. Rev.*, Vol. 1, 1945-1946, pp. 185-188 and 00-00.

³⁰ George B. White: *The Development of the Eastern Fraser Valley*, *British Columbia Hist. Quart.*, Vol. 12, 1948, pp. 259-291.

W. J. Anderson: *A Study of Land Settlement in the Prince George-Smithers Area, British Columbia*. 58 pp. *Canada Dept. of Agric. Publ. No. 794 (Tech. Bull. No. 62)*, 1947.

John Stainer: *Settlement Problems in British Columbia*, *Queen's Quart.*, Vol. 55, 1948, pp. 20-26.

³¹ J. L. Robinson: *Physical Geography of the Canadian Western Arctic*, *Canada Year Book 1948-49*, Ottawa, 1949, pp. 9-18.

"Permafrost in Canada,"³² which received the University Essay Award of the Royal Geographical Society for 1948, was published in *Arctic*; it contains the results of research conducted under the aegis of the new Geographical Bureau and corroborates the conclusion reached by earlier students that permafrost will always be deeper where there is no permanent ice cover. A preliminary map shows the approximate southern limit of permanently frozen ground in Canada. In a later number of *Arctic* (Vol. 2, 1949, pp. 79-89) Professor F. Kenneth Hare of McGill teams up with Margaret R. Montgomery to report on "Ice, Open Water, and Winter Climate in the Eastern Arctic of North America." Of special interest is their disagreement with the popular theory that Hudson Bay does not freeze over in winter.

Arctic also presented, in 1949, two studies of much ecological interest. Dr. Ilmari Hustich of the University of Helsinki offered a new phytogeographical classification of the Labrador peninsula (*ibid.*, pp. 36-42), with maps showing his ecological divisions and those of Halliday, the generally accepted authority. Professor Nicholas Polunin of McGill University has spent many seasons in the Arctic, and his work has contributed notably to our knowledge of its flora. Of particular interest in his present article (*ibid.*, pp. 45-55) are his remarks concerning the abundance of living bacteria and fungal spores in the Arctic atmosphere at an altitude of 5000 feet; examination found that some of the spores were those of pathogens of cereal crops of western Canada. The third part of Professor Polunin's major research publication, "Botany of the Canadian Eastern Arctic," entitled "Vegetation and Ecology," appeared in 1948,³³ and a book, "Arctic Unfolding,"³⁴ has also been published. Hugh Raup's excellent reports³⁵ on his ecological studies in the Northwest provide some westward extension of the work of Hustich and Polunin.

Some attention has been paid³⁶ to the diversion of the Ogoki River, formerly a tributary of the Albany, from the James Bay watershed to that of Lakes Nipigon and Superior. The diversion was undertaken by the Hydro-Electric Power Commission of Ontario to compensate for extra water drawn from the Great Lakes system at Niagara. Residents of the area have complained that the level of the lakes, Ontario in particular, has thus been raised sufficiently to cause considerable local damage to property.

From the long list of postwar publications by the Geological Survey of Canada two are,

³² John L. Jenness: Permafrost in Canada: Origin and Distribution of Permanently Frozen Ground, With Special Reference to Canada, *Arctic*, Vol. 2, 1949, pp. 13-27, and 2 maps following p. 76. Compare with S. W. Muller's lengthy study (Permafrost or Permanently Frozen Ground and Related Engineering Problems, Ann Arbor, Mich., 1947) reviewed by Robert F. Black in the *Geographical Review*, Vol. 38, 1948, pp. 686-687, and see also the note on Jenness' article, *ibid.*, Vol. 40, 1950, pp. 139-140.

³³ vii and 304 pp. *Natl. Museum of Canada Bull. No. 104 (Biol. Ser. No. 32)*. 75 cents. Part 1, *ibid.*, No. 92 (*Biol. Ser. No. 24*), was published in 1940; Part 2 (in collaboration), *ibid.*, No. 97 (*Biol. Ser. No. 26*), in 1947.

³⁴ Nicholas Polunin: *Arctic Unfolding: Experiences and Observations during a Canadian Airborne Expedition in Northern Ungava, the Northwest Territories, and the Arctic Archipelago*. 348 pp. Hutchinson & Co., London, New York, etc., 1949. 21s.

³⁵ Hugh M. Raup: Forests and Gardens along the Alaska Highway, *Geogr. Rev.*, Vol. 35, 1945, pp. 22-48.

Idem: Phytogeographic Studies in the Athabaska-Great Slave Region, *Journ. Arnold Arboretum*, Vol. 27, 1946, pp. 1-85.

Idem: The Botany of Southwestern Mackenzie. 275 pp. *Sargentia*, No. 6. Arnold Arboretum of Harvard University, Jamaica Plain, Mass., 1947. \$5.00.

³⁶ Hydro-Electric Power Commission of Ontario: The Ogoki Saga, *Inland Seas*, Vol. 4, 1948, pp. 15-21.

Rowley Murphy: Water against Land, *ibid.*, pp. 75-82.

rather arbitrarily, selected as examples.³⁷ W. A. Johnston's study of glacial Lake Agassiz introduces some interesting correlations with postglacial chronology elsewhere; he dates the beginning of the lake as 23,000 years ago. Bostock's fine report on the physiography of the northern Canadian Cordillera, of value in itself, also prompts mention of Victor Meek's brief remarks³⁸ on the techniques of glacier observation in the Cordillera, which are accompanied by as fine a set of photographs of Canadian glaciers as has been assembled in one publication. A geological work that geographers may read with profit is Lincoln Washburn's study³⁹ of the Victoria Island area. The emphasis is geomorphological, but more on process than on form; of especial interest is the discussion of solifluction and its associated *Strukturboden*.

An interesting by-product of Marie Sanderson's studies of the climates of Canada according to the new Thornthwaite classification⁴⁰ is her report on drought in the Canadian Northwest,⁴¹ in which she finds that most of the region belongs in Thornthwaite's dry sub-humid class, a somewhat startling conclusion for the many who have spent summers there with almost perpetually wet feet! This apparent anomaly is explained as the result of poor drainage rather than of humid climate—that is, the muskeg is to be considered largely a legacy from Pleistocene glaciation rather than attributable to abnormally low evaporation.

MAPPING AND EXPLORATION

A detailed discussion of the progress of official topographic and other mapping in Canada would require a review in itself. However, a few works concerned with some fringing problems deserve mention. Reports have become available of the exploration and reconnaissance mapping of the Purcell Range and the Lloyd George Mountains of British Columbia;⁴² in the current excitement about Canada's Far North it is sometimes forgotten that many of the Cordilleran areas in lower latitudes are little known. The description of a water-power survey on the Hamilton River, Labrador,⁴³ suggests particular problems in surveying

³⁷ W. A. Johnston: Glacial Lake Agassiz, With Special Reference to the Mode of Deformation of the Beaches. v and 20 pp. *Canada Geol. Survey Bull. No. 7*, 1946. 10 cents.

H. S. Bostock: Physiography of the Canadian Cordillera, With Special Reference to the Area North of the Fifty-Fifth Parallel. ix and 106 pp. *Canada Geol. Survey Memoir 247*, 1948. 25 cents. (Reviewed by Richard Foster Flint, *Geogr. Rev.*, Vol. 39, 1949, pp. 343-344.)

³⁸ Victor Meek: Glacier Observations in the Canadian Cordillera, *Canadian Geogr. Journ.*, Vol. 37, 1948, pp. 190-209. Mr. Meek is controller and chief engineer of the Dominion Water and Power Bureau, Department of Mines and Resources.

³⁹ A. L. Washburn: Reconnaissance Geology of Portions of Victoria Island and Adjacent Regions, Arctic Canada. xi and 142 pp. *Geol. Soc. of America Memoir 22*, 1947.

⁴⁰ Marie Sanderson: The Climates of Canada According to the New Thornthwaite Classification, *Scientific Agriculture*, Vol. 28, 1948, pp. 501-517.

⁴¹ *Idem*: Drought in the Canadian Northwest, *Geogr. Rev.*, Vol. 38, 1948, pp. 289-299.

⁴² J. Monroe Thorington: The Purcell Range of British Columbia. x and 152 pp. The American Alpine Club, New York City, 1946.

N. E. Odell: Exploration of the Lloyd George Mountains in British Columbia, *Canadian Geogr. Journ.*, Vol. 38, 1949, pp. 48-63.

F. S. Smythe: An Expedition to the Lloyd George Mountains, North-East British Columbia, *Geogr. Journ.*, Vol. 111, 1948, pp. 158-171.

⁴³ G. H. Desbarats: Surveying on the Hamilton River, Labrador, *Canadian Geogr. Journ.*, Vol. 37, 1948, pp. 214-229.

and mapping. The general usefulness of aerial photographs has been stressed by various writers,⁴⁴ and the *Canadian Geographical Journal* for May, 1946, carried an exceptionally lucid popular discussion of techniques in aerial photography and mapping, which is strongly commended to teachers.⁴⁵

CONSERVATION AND PLANNING

Serious studies of depletion and conservation of resources in Canada have continued during the past few years. Two articles by E. S. Hopkins⁴⁶ describe the problem for all of Canada as it appeared in 1947. The proceedings of a conservation conference held at Kingston early in 1945,⁴⁷ to which Professor D. F. Putnam and other experts contributed, present new data on eastern Ontario but nothing of unusual interest in the way of recommendations. The New Brunswick branch of the Agricultural Institute of Canada published the results of its studies in 1948,⁴⁸ with a full discussion of resource deterioration and suggested amelioration. One resource of the Maritime Provinces, the diked, formerly tidal, marshes of the Fundy shores, is badly in need of conservation and rehabilitation, and W. W. Baird,⁴⁹ superintendent of the Dominion Experimental Farm at Nappan, Nova Scotia, has strong opinions on the matter. With the reservation that his conclusions are open to debate, the reviewer recommends a reading of Baird's views. Certainly historical studies suggest the desirability of greater experimentation with cropping on the dikelands, particularly of fruits and vegetables, and less attention to the local production of beef.

More significant is the report of the Ontario Royal Commission on Forestry, 1947,⁵⁰ which is a strong indictment of poor husbandry of forest resources in the province. A partial solution is suggested by E. J. Zavitz,⁵¹ chief of the Division of Reforestation in Ontario's Department of Lands and Forests, who advocates extensive tree planting, particularly in the settled areas. In land once clothed with an unbroken forest cover, "today 135 townships have less than five per cent, and Southern Ontario less than ten per cent of woodland."

The Prairie Farm Rehabilitation Act has achieved some notable results, among them the regrassing of large areas of farms abandoned during the droughts and economic distress of the thirties, which are now being used as community pastures for the grazing of cattle. A part of the story is told by the then (1947) director, George Spence, in the *Canadian Geo-*

⁴⁴ For example: J. Fergus Grant: Air Photographs Speed Reconstruction, *Canadian Geogr. Journ.*, Vol. 33, 1946, pp. 18-37.

G. Barrette: La photographie aérienne et les problèmes forestiers d'après-guerre, *La Forêt Québécoise*, 1946, pp. 305-311.

⁴⁵ J. M. Bishop: Aerial Surveys in Ontario, *Canadian Geogr. Journ.*, Vol. 32, 1946, pp. 214-225.

⁴⁶ E. S. Hopkins: Soil Conservation in Canada, *Agric. Inst. Rev.*, Vol. 2, 1947, pp. 7-11.

Idem: A Soil Conservation Program for Canada, *ibid.*, pp. 335-343.

⁴⁷ "Conservation in Eastern Ontario." 132 pp. *Papers and Proc. Conference on Conservation in Eastern Ontario, Kingston, February 2 and 3, 1945*. Department of Planning and Development, Toronto, 1946.

⁴⁸ "Soil Conservation and Land Use in New Brunswick," *Agric. Inst. Rev.*, Vol. 3, 1948, pp. 213-217 +.

⁴⁹ W. W. Baird: Dykeland Improvement in the Maritimes, *Agric. Inst. Rev.*, Vol. 2, 1947, pp. 101-103.

⁵⁰ [Howard Kennedy:] Report of the Ontario Royal Commission on Forestry, 1947. xiii and 196 pp. King's Printer, Toronto, 1947. \$1.00. (Reviewed by A. R. M. Lower, *Canadian Journ. of Econ. and Polit. Sci.*, Vol. 14, 1948, pp. 507-510.)

⁵¹ E. J. Zavitz: Reforestation in Ontario, *Canadian Geogr. Journ.*, Vol. 34, 1947, pp. 156-180. See also papers dealing with Canada presented at the Fifth British Empire Forestry Conference, London, 1947.

graphical Journal.⁵² The scope of the work is indicated by an irritatingly illegible photograph of a large map of the region, which would be of wide interest if it could be read. The photographs, however, are of the usual high quality.

Publications give little attention to regional planning in Canada, though Professor Hare has discussed the general problem, with examples from "North American experiments."⁵³ Land planning, of course, demands previous land classification, of the type Reeds has suggested in his study of central Ontario noted above (p. 292). An economist's viewpoint of such problems of classification is presented by B. A. Campbell.⁵⁴

AGRICULTURE

As an introduction to contemporary problems in the Canadian economy, a brief article by Wallace Goforth⁵⁵ serves admirably. He catalogues the regional losses and gains of population in terms of mechanization of agriculture in Saskatchewan, the demand for metals, lumber, and fish in British Columbia, the shift from gold to base metals in the northern areas, and the lag of industrial production and employment in the Maritime Provinces. He also calls attention to changes in external economic relations, particularly the implications of loss of ability to earn United States dollars in Britain and the fact that the United States contributed some 78 per cent of Canada's imports in 1947 as against 61 per cent in 1938.

Although Canada has long since ceased to be a predominantly agricultural nation, agricultural problems remain the most serious in the economy, and agricultural studies are of prime interest to geographers. The historical and political backgrounds of Canadian agriculture are of more than passing interest in view of the current renaissance of the historical approach in geography. To a filling in of these backgrounds Paul F. Sharp⁵⁶ has contributed an important study, which makes clear the parallelism of social, economic, and political developments on both sides of the western Canada-United States boundary. Despite some oversimplification and a strong element of environmental determinism, there is much sense in what he has to say:

Canadian historians have paid scant heed to the fundamental similarities in environment that produced the same agrarian protests on both sides of the international boundary. This environment created similar problems of production, transportation, marketing, and relations with eastern metropolitan areas. . . .

American historians have often forgotten that the agricultural frontier lingered on in western Canada after it had disappeared in the United States. Thus the influence of a frontier region on American agriculture continued for many years after the American frontier had officially passed away. . . .

⁵² George Spence: Soil and Water Conservation on the Prairies, *Canadian Geogr. Journ.*, Vol. 35, 1947, pp. 226-241. For a supplementary note see G. N. Denike and J. E. Beamish: Land Improvement in Western Canada, *Agric. Inst. Rev.*, Vol. 2, 1947, pp. 94-96 and 136.

⁵³ F. Kenneth Hare: Regionalism and Administration: North American Experiments, *Canadian Journ. of Econ. and Polit. Sci.*, Vol. 13, 1947, pp. 563-571.

⁵⁴ *Idem*: Regionalism: A Development in Political Geography, *Public Affairs*, Vol. 10, 1946, pp. 34-39.

⁵⁵ B. A. Campbell: Economic Land Classification as Applied to Eastern Canada, *Economic Annalist*, February, 1946, pp. 12-17.

⁵⁶ Wallace Goforth: Canada's Economic Future, *Internatl. Journ.*, Vol. 3, 1948, pp. 285-308.

⁵⁶ Paul F. Sharp: The Agrarian Revolt in Western Canada: A Survey Showing American Parallels. ix and 204 pp. University of Minnesota Press, Minneapolis; Oxford University Press, London, 1948. \$3.00.

. . . The impact of the American republic has been great upon life in every section of the dominion, but nowhere is it more pronounced than in the Canadian West. The American farmers who helped to settle that vast region carried with them an agrarian experience which had matured under the stimuli of similar conditions in the American West (pp. vii-viii).

Of more general interest is Professor Vernon Fowke's history of Canadian agricultural policy.⁵⁷ Even though the emphasis is not on the changing patterns on the land itself, no student of the historical geography of any part of Canada can afford to miss a careful reading of this book. Fowke's generalizations give evidence of the lack of previous detailed work in agricultural history in certain areas, not least in the Maritime Provinces. No one is working more effectively to fill this lacuna than Professor R. L. Jones.⁵⁸ His study of agriculture in Lower Canada, 1792-1815, has been followed by two genuinely fine contributions, "History of Agriculture in Ontario, 1613-1880" and "The Old French-Canadian Horse." The Ontario study, however, is not sufficiently concerned with habitat quality.

To supplement Goforth's general article on the economy, the effects of wartime stresses and strains on Canadian agriculture have been summarized by both Professors Fowke and W. M. Drummond.⁵⁹ Fowke points out that the wartime shift to emphasis on livestock in the Prairie Provinces has largely been reversed, and he too speaks of the drift of prairie population to British Columbia and Ontario.

As examples of the article that deals with a particular theme, the following are selected from the *Agricultural Institute Review*. In December, 1945 (Vol. 1, pp. 93-99), E. S. Archibald did some forecasting on "The Future of the Livestock Industry in Western Canada," pointing out the possibilities for expansion in sheep raising. In March, 1948 (Vol. 3), the *Review* concentrated its attention on sheep, with "The Place for Sheep in Canada" by E. S. Archibald (pp. 79-81), "Types and Breeds of Sheep in Canada" by H. J. Hargrave and S. A. Hilton (pp. 89-92), "Sheep Production in Western Canada" by A. H. Ewen (pp. 93-96), and "Sheep Production in Eastern Canada" by L. H. Hamilton (pp. 97-101).

E. C. Stacey⁶⁰ has reviewed some of the standard theories on climatic factors affecting crop production in Canada, without, however, adding particularly to our knowledge. More useful is Charles W. Johnson's thoughtful study of the "Relative Decline of Wheat in the Prairie Provinces of Canada."⁶¹ Wheat production has decreased for a great variety of reasons, not the least of which is depletion of soil fertility to a level below which wheat production

⁵⁷ Vernon C. Fowke: *Canadian Agricultural Policy: The Historical Pattern*. xii and 304 pp. The University of Toronto Press, Toronto, 1946. \$3.50.

⁵⁸ Robert Leslie Jones: *Agriculture in Lower Canada, 1792-1815*, *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 33-51.

Idem: *History of Agriculture in Ontario, 1613-1880*. xvi and 420 pp. The University of Toronto Press, Toronto, 1946. \$4.25. Also published as *University of Toronto Studies, History and Economics Series*, Vol. 11, 1946.

Idem: *The Old French-Canadian Horse: Its History in Canada and the United States*, *Canadian Hist. Rev.*, Vol. 28, 1947, pp. 125-155.

⁵⁹ Vernon C. Fowke: *Canadian Agriculture in the Postwar World*, in *Features of Present-Day Canada*, edited by Robert Hamilton Coats, *Annals Amer. Acad. of Polit. and Soc. Sci.*, Vol. 253, 1947, pp. 44-51.

W. M. Drummond: *Canada's Agricultural Wartime Experience and Policy*, *Canadian Banker*, Vol. 53, 1946, pp. 115-129.

⁶⁰ E. C. Stacey: *Climatic Factors Affecting Crop Production*, *Scientific Agriculture*, Vol. 26, 1946, pp. 79-82.

⁶¹ *Econ. Geogr.*, Vol. 24, 1948, pp. 209-216.

is no longer profitable. The introduction of two to four years of grass into a 15- or 16-year rotation, as is now officially advocated, would reduce the area in wheat at any one time, but this might be offset by increased yield due to increased soil fertility.

Besides adding grass to rotations, stripping grain fields with grass balks, digging water-storage pits called "tanks," and a dozen similar practices that are, essentially, extensions of dry-farming methods, interest on the prairies has been turning more and more to irrigation, as H. G. Long,⁶² a western newspaper editor and a first-class agricultural writer, describes, with the accompaniment of a good, clear map. There is a careful analysis of the economics of irrigation, and an attempt to balance social and economic costs and benefits. He observes that only a small area can ever be irrigated, but that irrigation should be pushed to stabilize and maintain existing agriculture and to assure a water supply to such cities as Regina and Moose Jaw, which have faced recurrent serious shortages.

Among the contributory causes of reduced wheat acreage on the prairies are the depredations of the sawfly. A. W. Platt⁶³ describes the work undertaken to breed a wheat resistant to sawfly and the resulting Rescue variety. In order to step up development, it was grown in two crops a year (one in winter in Southern California). Since its release in 1946, published reports have been meager, but the reviewer learned, on a personal visit to Saskatchewan in the summer of 1949, that its reception has been mixed; its resistance to sawfly has been clearly demonstrated, but its disadvantages in other ways have dampened enthusiasm. Nevertheless, its use is spreading.

The Prairie Farm Rehabilitation Act's community pastures and the existence in Saskatchewan of Canada's only Socialist government make the growth of cooperative farming in the most populous Prairie Province easily understandable. Wright, who contributed much the best of the *Canadian Geographical Journal's* series of provincial descriptions, has written with the same good sense and liveliness of this movement.⁶⁴

One more publication of interest on Canadian agriculture is an article on white hybrid corn in Ontario.⁶⁵ Hybrid corns were introduced into the province in 1938, and by 1944 they had captured almost 95 per cent of the commercial acreage of grain corn. In that year 567,000 acres of corn was grown in Ontario, nearly 100,000 more than the 1932-1941 average.

FORESTS AND FISHERIES

The best general summary of the forest and lumbering situation is "The Canadian Forest and Its Future" by John C. W. Irwin.⁶⁶ He points out that only about two-thirds of Canada's 1,290,960 square miles of forested area can produce continuous timber crops and that, of this two-thirds, only about one-half is economically accessible at present. However, this one-third of the forest area contains nearly two-thirds of the cubic footage of timber.

⁶² H. G. Long: *Prairie Irrigation*, *Canadian Geogr. Journ.*, Vol. 33, 1946, pp. 152-159. See also C. C. Spence and others: *Farming in the Irrigation Districts of Alberta*. 66 pp. *Canada Dept. of Agric. Publ. No. 793 (Tech. Bull. No. 61)*, 1947.

⁶³ A. W. Platt: *Breeding Wheats for Sawfly Resistance*, *Canadian Geogr. Journ.*, Vol. 33, 1946, pp. 138-141.

⁶⁴ Jim Wright: *Co-operative Farming in Saskatchewan*, *Canadian Geogr. Journ.*, Vol. 39, 1949, pp. 68-90.

⁶⁵ Max Braithwaite: *White Hybrid Corn in Ontario*, *Canadian Geogr. Journ.*, Vol. 35, 1947, pp. 189-195.

⁶⁶ *In Features of Present-Day Canada* (see footnote 59, above), pp. 52-58.

Although the rate of growth, on the average, exceeds the rate of depletion by fire, fungi, insects, and cutting, in the most accessible areas the ratio is seriously reversed.

Other articles on the Canadian lumber industry deal with Canada's contribution to the British lumber market, farm wood lots as sources of commercial lumber in the Maritime Provinces and of fuel in Quebec, and recent changes in the lumber industry of the eastern seaboard.⁶⁷ A personal interest in historical geography has brought to the reviewer's attention several historical studies of timber production and associated industries that others might also like to read.⁶⁸ Useful, if of narrower appeal, is a bibliography of the maple-sugar industry that appeared in the April, 1949, number of the *Canadian Geographical Journal* (p. viii).

Ian S. McArthur, chief economist of the Department of Fisheries, Ottawa, contributed an article on "The Fisheries of Canada" to "Features of Present-Day Canada" (pp. 59-65; see footnote 59, above), and general accounts of the fishing industry in different parts of the Dominion, or of its branches, have appeared regularly in the *Canadian Fisherman* and other periodicals.⁶⁹ Two articles in the *Canadian Geographical Journal* seemed to the reviewer to have more than routine interest: Peter Gordon's description of "Commercial Winter Fishing in Manitoba" (Vol. 36, 1948, pp. 2-8) and A. L. Pritchard's report on "The Skeena River Salmon Investigation" (Vol. 39, 1949, pp. 60-67). The salmon fishery of the 300-mile Skeena, outranked in size and as a salmon producer by only the Fraser among British Columbia's rivers, faced a serious decrease in salmon runs in 1942 and 1943. A resulting survey in 1944 suggested that the fishery was mainly responsible for the general decline, but year-to-year fluctuations were attributed largely to variations in weather and their manifold effects on conditions for spawning and incubation, which set up a chain of periodic fluctuations of abundance and scarcity, to such predators as the hair seals in the lower harbor, to Indian fishing practices, or to the presence of stream obstructions.

MINING AND INDUSTRY

A useful general reference on "The Canadian Mining Industry Today" by Alex Skelton also appears in "Features of Present-Day Canada" (pp. 66-73). He draws attention to the decline of gold in favor of base metals, the bright prospects for iron mining (at Steep Rock

⁶⁷ G. W. I. Creighton: Place of Farm Woodlots and Town Forests in Maritime Production, *Canadian Lumberman*, Sept. 1, 1945, pp. 79 and 98.

L. de G. Dubois: L'utilisation du bois de ferme comme combustible, *La Forêt Québécoise*, Vol. 12, 1947, pp. 591-593.

E. S. Fellows: Some Changes in the Lumber Industry of the Maritimes, *Forestry Chronicle*, September, 1946, pp. 172-181.

J. L. Ilsley: Importance of Canada in British Timber Trade, *Canadian Lumberman*, May 1, 1945, pp. 55 and 106.

⁶⁸ Herbert Carmichael: Pioneer Days in Pulp and Paper, *British Columbia Hist. Quart.*, Vol. 9, 1945, pp. 201-212.

Nina L. Edwards: The Establishment of Papermaking in Canada, *Ontario History*, Vol. 39, 1947, pp. 63-74.

W. S. MacNutt: The Politics of the Timber Trade in Colonial New Brunswick, 1825-40, *Canadian Hist. Rev.*, Vol. 30, 1949, pp. 47-65.

W. R. Williams: Big Tugs and Big Rafts: A Story of Georgian Bay Lumbering, *Inland Seas*, Vol. 3, 1947, pp. 11-16.

⁶⁹ For example, Hormidas-D. Langlais: Considérations sur les pecheries maritimes du Québec *L'Actualité Économique*, Vol. 22, 1946-1947, pp. 458-475.

Lake, and in the Labrador-Quebec border area, with its more than 20,000 square miles of high-grade hematite deposits), the new Lynn Lake nickel-copper find in Manitoba, which may create a "junior" Sudbury, the improved outlook for asbestos, and the serious decline in man-day productivity in the Cape Breton coal mines. Unfortunately, his article appeared too early to include the new oil developments in northern Alberta.⁷⁰ Other articles on specific topics may be found in Canadian and American scientific journals devoted to geological and mining problems. One likely to be of particular geographical interest is L. H. Cole's "Potash Discoveries in Western Canada."⁷¹

Contributions to an industrial geography of Canada have been disappointingly few, though the *Monetary Times* and *Canadian Business* in particular add some data and interpretations to the material on manufacturing to be found in the *Canada Year Book* and other available official sources. In "Power and Manufacturing in Canada" (Features of Present-Day Canada, pp. 74-80), Lesslie R. Thomson discusses wartime expansion, reconversion, and some possibly permanent changes in the manufacturing pattern, especially the great expansion of the aluminum industry in the Lake St. John area, which is also discussed by B. J. McGuire and H. E. Freeman.⁷² Thomson expects power developments in the west, associated with irrigation projects, new sources of iron ore, and the St. Lawrence seaway (if completed), further to alter established patterns. Largely pictorial reporting on specific industries has appeared from time to time in the *Canadian Geographical Journal*.⁷³

The possibilities in electric-power development suggested by M. J. McHenry⁷⁴ in 1945 are being slowly realized, and the increased production of power for aluminum and pulp-paper industries and the new diversion of water into the Great Lakes have been mentioned in writings already discussed.

TRANSPORTATION AND TRADE

The popular official handbook "Canada 1946" is chiefly descriptive, but certain parts may repay reading, particularly R. H. Ayre's article on Trans-Canada Air Lines,⁷⁵ which provides a résumé of the development of aviation in Canada and the evolution of T.C.A. and notes on official policy affecting the air-transportation industry. Much of the writing on northern Canada, reviewed in its regional group above, emphasizes the role of planes in the roadless North.⁷⁶

⁷⁰ See the special Canadian issue of *World Oil*, December, 1949 (Vol. 129, No. 9), which includes an article by Roy E. Leigh, "Expansion in Western Canada" (pp. 221-228), and a (separate) map of oil and gas fields in Alberta and Saskatchewan, 1:1,350,000.

⁷¹ *Canadian Mining and Metallurgical Bull.*, Vol. 41, 1948, pp. 149-158.

⁷² B. J. McGuire and H. E. Freeman: How the Saguenay River Serves Canada: The Manufacture of Aluminum, *Canadian Geogr. Journ.*, Vol. 35, 1947, pp. 200-225.

⁷³ For example: S. G. Cooper: The Canadian Woollen and Knit-Goods Industry, *Canadian Geogr. Journ.*, Vol. 33, 1946, pp. 174-185.

Lawrence F. Jones: The Automobile Industry in Canada's Economy, *ibid.*, Vol. 37, 1948, pp. 86-98.

⁷⁴ M. J. McHenry: Rural Electrification: Development and Post-War Plans in Canada, *Engineering Journ.*, Vol. 28, 1945, pp. 703-706.

⁷⁵ R. H. Ayre (under the direction of W. F. English): Trans-Canada Air Lines—Its Place in the Field of Civil Aviation in Canada, in *Canada 1946: The Official Handbook of Present Conditions and Recent Progress*, Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa, 1946 (25 cents), pp. 15-27.

⁷⁶ Additional references are: F. V. C. Hewett and W. J. McDonough: Flying and Mining in Canada, *Air Affairs*, Vol. 1, 1946-1947, pp. 233-241.

Frank Illingworth: Canada's Arctic Aviation, *Contemporary Rev.*, April, 1949, pp. 238-241.

Currie remains the chief source of information on rail transportation. In addition to the appropriate parts of his "Economic Geography of Canada" noted above (p. 288), he contributed "The Transportation Problem" to "Features of Present-Day Canada" (pp. 81-87), which gives a brief but excellent summary of the financial position of the two major rail systems 1923-1947, and, in another journal,⁷⁷ a useful discussion of the effect of freight rates—often arbitrarily determined by exigencies of monopolistic competition or political expediency—on regional economies. This last is of the greatest importance in a national economy still racked by the strain of dependence on a narrow range of staple exports.

A note in *Engineering and Contract Record* for September, 1947, "Manitoba Designs Concrete Highways to Withstand Western Climate,"⁷⁸ suggests the improvements being made in highway construction in the west, but little else of significance has been written about Canada's road system. The reviewer has turned up only one useful work on the St. Lawrence seaway,⁷⁹ but its stress on navigational aspects makes it of particular importance. If a personal interest in the history of transportation may be intruded here, attention is drawn to an early description of Indian canoes in the northeast⁸⁰ and two articles in *The Beaver*, that most readable house organ of the Hudson's Bay Company, concerning the York boats formerly used on the rivers tributary to the bay and early seagoing ships in the bay itself.⁸¹

As regards trade, Douglas H. Fullerton has given us many useful contributions in the journal of the Department of Trade and Commerce, Ottawa.⁸² He particularly emphasizes the trend, first evident in the thirties, strengthened by the war, and likely to continue, from predominance of raw materials in exports to predominance of manufactures.

POPULATION PROBLEMS

Aside from a discussion of "Problems in Census Taking" by the Chief of the Census Division of the Dominion Bureau of Statistics⁸³ and a contribution by a former Dominion Statistician,⁸⁴ both of which have considerable technical interest, attention in Canada has been concentrated on the future population, its probable rate of growth, and the desirability of accelerated immigration. Interest in these questions is used as a springboard by J. W. Watson in his study of "Rural Depopulation in Southwestern Ontario,"⁸⁵ which, nevertheless, also fulfills the regional promise of its title. He concludes: "Thus the end-product of depopulation in rural Ontario may well be better churches, better schools, and better farms.

⁷⁷ A. W. Currie: Freight Rates and Regionalism, *Canadian Journ. of Econ. and Polit. Sci.*, Vol. 14, 1948, pp. 427-440.

⁷⁸ Pp. 72-75, 122-127, and 130-134.

⁷⁹ Daniel W. Hoan: The St. Lawrence Seaway—Navigation Aspects, *Canadian Geogr. Journ.*, Vol. 36, 1948, pp. 52-69.

⁸⁰ Ferdinand E. Chatard: An Early Description of Birch-Bark Canoes, *Amer. Neptune*, Vol. 8, 1948, pp. 90-98.

⁸¹ Richard Glover: York Boats, *The Beaver*, Outfit 279, March, 1949, pp. 19-23.

Alice M. Johnson: Early Ships in Hudson's Bay, *ibid.*, Outfit 277, June, 1946, pp. 10-13.

⁸² For example, "Primary Products Head Canadian Exports since Confederation," *Foreign Trade*, Vol. 1, 1947, pp. 1150-1154. See also his "Eighty Years of Foreign Trade," *Canadian Geogr. Journ.*, Vol. 35, 1947, pp. 106-121, and "Survey of Canadian Foreign Trade," in *Features of Present-Day Canada* (see footnote 59, above), pp. 143-149.

⁸³ O. A. Lemieux: Problems in Census Taking, *Canadian Journ. of Econ. and Polit. Sci.*, Vol. 14, 1948, pp. 469-480.

⁸⁴ R. H. Coats: Beginnings in Canadian Statistics, *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 109-130.

⁸⁵ *Annals Assn. of Amer. Geogr.*, Vol. 37, 1947, pp. 145-154.

If this were substantiated, it would obviously be unsound to press for large-scale immigration, as is being done, whether it were physically feasible or not" (p. 154). After examining similar evidence over the whole of Canada and discussing regional, rural-urban, and occupational trends, W. Burton Hurd, one of Canada's principal demographers, comes to a similar conclusion in "Demographic Trends in Canada" (Features of Present-Day Canada, pp. 10-15). Both Watson and Hurd stress the importance of the re-emigration to the United States of so many of Canada's past immigrants. B. K. Sandwell,⁸⁶ however, believes that a considerable immigration is needed for the large amount of relatively rough and unskilled work which must go on; he thinks that Canada is educating her young people to skills which they cannot all apply and to tastes which they cannot all satisfy. Professor H. F. Angus,⁸⁷ in two ardent pleas for a rational immigration policy, to be reflected both in law and in practice, suggests the desirability of a small but steady stream of immigration, though he is careful not to commit himself to precise figures. As forecasts of future Canadian population, we have the estimate of Griffith Taylor⁸⁸ and Blanchard's conclusion that Quebec could carry double its present population at present resource and technique levels.⁸⁹

POLITICAL GEOGRAPHY

It is hoped that geographers interested in the Canadian political scene are familiar with the relatively new Canadian periodical *International Journal* and with such major contributions as R. M. Dawson's "The Government of Canada."⁹⁰ To them, Professor A. R. M. Lower's provocative opinion that "What This Country Needs Is Ten New Provinces,"⁹¹ in which he advocates cutting up the larger "imperialistic provinces," should be generally interesting. There has been no recent discussion of an opposing opinion often advanced that the Prairie Provinces and the Maritime Provinces should be consolidated into two single provinces to balance the pressure from central Canada, i.e. Quebec and Ontario. Professor Lower, now an Ontarian but long a resident of Winnipeg, might conceivably agree to this as a substitute. Most vexed of politico-geographical problems, however, is not that of inter-provincial relations but that of Dominion-provincial relations, which neither the Rowell-Sirois report of 1940 nor subsequent conferences have solved, though temporary agreements on certain taxation questions were reached by the Dominion government and six of the provinces in 1946. These matters are ably discussed by Wilfrid Eggleston in a contribution to "Features of Present-Day Canada" (Dominion-Provincial Relations, pp. 40-43).

J. B. Brebner has followed his well-known "North Atlantic Triangle" (1945) with a

⁸⁶ B. K. Sandwell: Population: A Canadian Problem, *Queen's Quart.*, Vol. 54, 1947, pp. 312-322.

⁸⁷ H. F. Angus: The Future of Immigration into Canada, *Canadian Journ. of Econ. and Polit. Sci.*, Vol. 12, 1946, pp. 379-386.

Idem: Need for an Immigration Policy, in Features of Present-Day Canada (see footnote 59, above), pp. 16-21.

⁸⁸ Canada (see footnote 3, above), p. 516. The concluding chapter of this book contains much the same data and conclusions given in his "Future Population in Canada: A Study in Technique," *Econ. Geogr.*, Vol. 22, 1946, pp. 67-74.

⁸⁹ Raoul Blanchard: Les excédents de population et l'agriculture dans la province de Québec, *L'Actualité Économique*, Vol. 24, 1948-1949, pp. 635-641. See also H. L. Robinson: The Population of Canada in 1971, *Public Affairs*, Vol. 10, 1947, pp. 184-190.

⁹⁰ Robert MacGregor Dawson: The Government of Canada. x and 662 pp. (Canadian Government Series, No. 2.) The University of Toronto Press, Toronto, 1947. \$5.50.

⁹¹ *Maclean's Mag.*, Vol. 61, No. 19, Oct. 15, 1948, pp. 7 and 77-79.

postscript, "A Changing North Atlantic Triangle,"⁹² which brings his discussion of Canadian-United States-United Kingdom relationships into the postwar period. Professor Brebner is, as always, stimulating, particularly in his clearly reasoned conclusion that Canada must move closer to the United States in many ways—not least in standard of living. When the relative standard of Canadian living falls, Canada has always lost population, and, by implication, she always will. Where Canada was once in the position of a can tied to the tails of two dogs (perhaps one of the principal causes of internal strain), she has now, in this war, had one of the strings considerably frayed. Canada's relations with the United States in the Pacific⁹³ and with the rest of the American republics⁹⁴ have also come under scrutiny recently. A more technical discussion, but perhaps of more central importance to political geography, is contained in a recent clear and concise summary of Canadian-American treaties bearing on the Great Lakes region.⁹⁵

Many Canadian observers prefer to see Canada as a newly emerging world power⁹⁶ with greater independence than the previous interpretations suggest. From that viewpoint, J. A. Gibson, Eric Harrison, and the present Secretary of State for External Affairs, Lester B. Pearson, have all within the past year examined Canada's important strategic position in the North Atlantic,⁹⁷ particularly in reference to the new regional pact. The significance of Newfoundland to that position was emphasized in works noted above.

STUDIES OF MINORITY GROUPS

The most elementary discussion of Canada usually includes some consideration of the cultural schism between the French-speaking and English-speaking groups. Two excellent studies of the French Canadians as seen from the outside⁹⁸ and one as seen from the inside⁹⁹ have become available since the war. Sandwell opens his article with these remarks: "There is a fundamental difference between the position of the French Canadians in Canada and that of any other minority on the North American Continent. It is that the French Canadians have no intention of being 'assimilated.' " He stresses that the difference between Canada's

⁹² J. Bartlet Brebner: A Changing North Atlantic Triangle, *Internatl. Journ.*, Vol. 3, 1948, pp. 309-319.

⁹³ G. M. Carter: Canadian-American Relations in the Pacific, in *This Is the Peace: Addresses Given at the Canadian Institute on Public Affairs*, edited by Violet Anderson, The Ryerson Press, Toronto, 1945 (\$1.25), pp. 69-79.

⁹⁴ Paul Redwood: *Canada, Inter-American Affairs 1945*, New York, 1946, pp. 82-99.

⁹⁵ Gilbert R. Johnson: United States-Canadian Treaties Affecting Great Lakes Commerce and Navigation, *Inland Seas*, Vol. 3, 1947, pp. 203-207, and Vol. 4, 1948, pp. 113-119.

⁹⁶ A. Mitchell: Canada as a World Power, *Amer. Mercury*, Vol. 63, 1946, pp. 48-55.

⁹⁷ James A. Gibson: Canadian Foreign Policy: A Forward View, *Internatl. Journ.*, Vol. 4, 1949, pp. 109-118.

Eric Harrison: Canada and the Atlantic Alliance, *Queen's Quart.*, Vol. 56, 1949, pp. 113-132.

Lester B. Pearson: Canada and the North Atlantic Alliance, *Foreign Affairs*, Vol. 27, 1948-1949, pp. 369-378.

⁹⁸ Mason Wade: *The French-Canadian Outlook: A Brief Account of the Unknown North Americans*, 192 pp. The Viking Press, New York, 1946. \$2.00.

B. K. Sandwell: *The French Canadians*, in *Features of Present-Day Canada* (see footnote 59, above), pp. 169-175.

⁹⁹ Jean-C. Bonenfant and Jean-C. Falardeau: Cultural and Political Implications of French-Canadian Nationalism, *Rept. Ann. Meeting Canadian Hist. Assn. Held at Toronto, May 23-24, 1946*, Toronto, 1946, pp. 56-73.

two main cultural groups is just that—cultural. In no sense is it racial. One of the handicaps of the French-speaking group is the larger numbers of children of school age and the consequent dilemma of heavier school taxation or poorer education. Also, to compete successfully in Canadian life, it is much more necessary for the young French Canadian to learn English than for the English-speaking Canadian to learn French; of Canadians of French origin in Canada, more than one-third are bilingual, whereas less than 4 per cent of those of British origin speak French. Finally, he emphasizes the political significance of the fact that, whereas prosperity, security, or liberty (or all three together) represents the political goal of the rest of the people of the continent, that of the French Canadian is ethnic survival.

If any one of the articles in "Features of Present-Day Canada" could be selected as more interesting than the rest to geographers, the reviewer believes Nathan Keyfitz's discussion of "Ethnic Groups and Their Behavior" (pp. 158-163) would deserve the palm. Perhaps its greatest importance is that it draws attention to the widely diverse cultural origins of Canada's people. Of the total population in 1941, about 50 per cent were British, half of them English, the other half "somewhat more Scottish than Irish." Thirty per cent were of French origin, 18 per cent "Other European," principally German, Ukrainian, Scandinavian, and Dutch. A little more than 1 per cent were Indian and Eskimo, 1 per cent Asiatic and African. Moreover, these ethnic groups are unevenly distributed, and a regional heterogeneity within the group from the British Isles, which often has sharp contrasts within itself, provides us with one of the most important generalizations that can be made about the human geography of Canada. Keyfitz discusses other important distributional aspects, such as the varying urban-rural proportions and degrees of segregation. Most interesting is the demonstration of the effectiveness of the melting pot among the groups of non-French origin, among whom intermarriage is becoming increasingly common.

Some of these groups have been studied from many points of view, and from the scattered material available it would seem that a most interesting "geography" of minority groups in Canada awaits some curious mind. There are new side lights on immigrants from the British Isles,¹⁰⁰ and on Mennonites and Amish.¹⁰¹

The first of a projected series of studies of Canadians of Ukrainian origin, the next group in size after British, French, and German, appeared in 1945;¹⁰² this and Vera Lysenko's otherwise useful volume¹⁰³ dealing with the same people are marred by the lack of maps. For two of the smaller groups interesting studies may be cited,¹⁰⁴ one on the Jews and brief notes by Professor H. F. Angus on the Orientals and East Indians. In 1946 there were some

¹⁰⁰ Thomas Guerin: *The Gael in New France*. 134 pp. Montreal, 1946. \$1.25.

James Alexander Roy: *The Scot and Canada*. 117 pp. McClelland & Stewart, Toronto, 1947. \$1.75.

¹⁰¹ Ernst Correll: *Canadian Agricultural Records on Mennonite Settlements, Mennonite Quart. Rev.*, Vol. 31, 1947, pp. 34-46.

Idem: *Mennonite Immigration into Manitoba: Documents & Sources 1873-1874, ibid.*, Vol. 32, 1948, pp. 43-57.

M. B. Dunham: *Mid-European Backgrounds of Waterloo County, Ontario Hist. Soc. Papers and Records*, Vol. 37, 1945, pp. 59-70.

E. K. Francis: *Mennonite Institutions in Early Manitoba: A Study of Their Origins, Agricultural History*, Vol. 22, 1948, pp. 144-155.

¹⁰² N. J. Hunchak: *Canadians of Ukrainian Origin: Vol. 1, Population*. 164 pp. Ukrainian-Canadian Committee, Winnipeg, 1945. \$1.00.

¹⁰³ Vera Lysenko: *Men in Sheepskin Coats: A Study in Assimilation*. viii and 312 pp. The Ryerson Press, Toronto, 1947. \$3.50.

¹⁰⁴ Louis Rosenberg: *The Jewish Population of Canada: A Statistical Summary from 1851 to 1941*.

1700 East Indians in Canada, including children, and Angus was exercised over the failure to enfranchise them.

URBAN GEOGRAPHY

Griffith Taylor's recent book on urban geography¹⁰⁵ contains a number of references to Canadian cities and settlements. Individual cities studied by other geographers are London, Ont., the near-by twin cities of Waterloo-Kitchener, and New Westminster, B. C.—the last a really excellent job.¹⁰⁶ Professor Raoul Blanchard took full advantage of his recent stay in Montreal to make a thorough study of that city,¹⁰⁷ which may serve to stimulate a more ambitious program of urban study by the profession in Canada. Few better models could be found.

Since the end of the war three periodicals have been publishing series of descriptive articles on Canadian cities: the *Canadian Geographical Journal*, the *Monetary Times*, and the *Empire Digest*. Among those in the *Journal* that by D. C. Harvey, archivist for Nova Scotia, on "Halifax, 1749-1949" (Vol. 38, 1949, pp. 6-37), written in honor of the bicentennial, is a particularly fine piece, with some penetrating observations on the evolution of the city.

Popular books about individual cities have provided little meat for geographers; brochures of the "Chamber of Commerce" type¹⁰⁸ have proved more useful, on the whole, than more ambitious studies. Of the latter, T. H. Raddall's "Halifax" and Lucien Brault's "Ottawa"¹⁰⁹ are apparently well documented and provide the most information. "The Rise of Toronto" by D. C. Masters¹¹⁰ is of broad general interest but shows an almost complete indifference to the physical milieu and pattern.

ANTHROPOLOGICAL AND HISTORICAL GEOGRAPHY

Professor T. F. McIlwraith's general outline of Indian life and economy, "The Indians of Canada," in "Features of Present-Day Canada" (pp. 164-168) may serve as an introduction

32 pp. (Canadian Jewish Population Studies, No. 2.) Canadian Jewish Congress, Montreal, 1947. 50 cents.

H. F. Angus: Asiatics in Canada, *Pacific Affairs*, Vol. 19, 1946, pp. 402-408.

Idem: East Indians in Canada, *Internatl. Journ.*, Vol. 2, 1947, pp. 47-50.

¹⁰⁵ Griffith Taylor: *Urban Geography: A Study of Site, Evolution, Pattern and Classification in Villages, Towns and Cities*. xv and 439 pp. [Methuen's Advanced Geographies.] Methuen & Co., London, 1949. 25s. (See also the review by E. G. R. Taylor, *Geogr. Journ.*, Vol. 114, 1949, pp. 100-101; and that by R. E. Dickinson, elsewhere in this number of the *Geographical Review*.)

¹⁰⁶ Edward Taube: The Growth of London, Ontario, *Canadian Geogr. Journ.*, Vol. 33, 1946, pp. 102-116.

Chun-fen Lee: Twin Cities of Waterloo and Kitchener, *Econ. Geogr.*, Vol. 22, 1946, pp. 142-147.

T. R. Weir: New Westminster, B. C., *Canadian Geogr. Journ.*, Vol. 36, 1948, pp. 22-38.

¹⁰⁷ Raoul Blanchard: Montréal: Esquisse de géographie urbaine (Études canadiennes, Troisième série, II), *Rev. de Géogr. Alpine*, Vol. 35, 1947, pp. 133-328. Also published separately by Imprimerie Allier, Grenoble, \$4.50. (See also the note by Peter H. Nash, *Geogr. Rev.*, Vol. 38, 1948, pp. 494-495.)

¹⁰⁸ For example: A. H. Wingfield, edit.: Hamilton, 1846-1946: One Hundred Years of Progress. 122 pp. Hamilton Centennial Committee, Hamilton, 1946. \$1.00.

John H. Archer, in collaboration with J. C. Bates: *Historic Saskatoon [1882-1947]: A Concise Illustrated History of Saskatoon*. 63 pp. Junior Chamber of Commerce, Saskatoon [1948?]. 50 cents.

¹⁰⁹ T. H. Raddall: *Halifax, Warden of the North*. xviii and 348 pp. McClelland & Stewart, Toronto, 1948. \$4.00.

Lucien Brault: *Ottawa, Old and New*. 349 pp. Ottawa Historical Information Institute, Ottawa, 1946. \$3.25.

¹¹⁰ D. C. Masters: *The Rise of Toronto, 1850-1890*. xi and 239 pp. The University of Toronto Press, Toronto, 1947. \$3.75.

to the past and present position of Canada's aboriginal people. The most detailed material to appear for any part of Canada is contained incidentally in various papers of the Peabody Foundation's symposium¹¹¹ published in 1946. William A. Ritchie's discussion of "Archaeological Manifestations and Relative Chronology in the Northeast" (pp. 96-105) is perhaps the piece most likely to interest historical geographers, though almost every one of the papers contained something to attract this reviewer's attention. For example, Douglas S. Byers' "The Environment of the Northeast" (pp. 3-32) is important because each aspect of the physical environment is examined in relation to the needs, equipment, and opportunities of primitive man.

American Antiquity and the *American Anthropologist* frequently carry articles on Canada. In 1946 the former had T. H. Manning's note on "Ruins of Eskimo Stone Houses on the East Side of Hudson Bay" (Vol. 11, pp. 201-202) and Frederick Johnson's "An Archaeological Survey along the Alaska Highway, 1944" (pp. 183-186). In the same year Douglas Leechman's "Prehistoric Migration Routes through the Yukon"¹¹² provided a cursory examination into the possibilities of various routes in the most critical area of discussion for the movement of aboriginal migrants from the Yukon Valley to the south and east. No precise dating of artifacts is attempted, though he cites authority for an age of 7000-9000 years ago at one site. The last volume of the reports of the Canadian Arctic Expedition, 1913-1918,¹¹³ also appeared in 1946, with much detail on the material culture of the Copper Eskimo.

There have, of course, been many general studies that deal incidentally with Canada, such as Lewis' "The Beginning of Civilization in America,"¹¹⁴ with its highly controversial theory of pre-Columbian cultural diffusion from the Americas to Eurasia by way of the Pacific islands; Burland's "American Indian Map Makers";¹¹⁵ and the Martin-Quimby-Collier opus,¹¹⁶ which has a rather full, if-semipopular, account of the Amerinds in general and a complete detailing of material culture. Its omission of arguments to support debatable viewpoints, although deliberate, is annoying.

Two of Canada's ablest historians have contributed general volumes on Canadian history with which every student of Canadian geography ought to make himself familiar. Edgar McInnis' "Canada"¹¹⁷ has the more conventional organization and a careful, deliberate prose that suggests the objective scholarship for which it has been widely commended. The usual few pages by which historians pay lip service to the notion that historical events do have a setting are devoted to physical geography and are a great improvement in both content and writing over similar introductions in most of the book's predecessors. The reviewer believes

¹¹¹ Frederick Johnson, edit.: *Man in Northeastern North America*. xi and 347 pp. *Papers Robert S. Peabody Foundation for Archaeol.*, Vol. 3. The Foundation, Phillips Academy, Andover, Mass., 1946. \$2.00.

¹¹² *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 383-390.

¹¹³ D. Jenness: *Material Culture of the Copper Eskimo*. vii and 148 pp. (Report of the Canadian Arctic Expedition, 1913-18, Vol. 16.) King's Printer, Ottawa, 1946.

¹¹⁴ Gilbert N. Lewis: *The Beginning of Civilization in America*, *Amer. Anthropologist*, Vol. 49 (N.S.), 1947, pp. 1-24. (See also the review by E. Estyn Evans, *Geogr. Rev.*, Vol. 39, 1949, p. 169.)

¹¹⁵ C. A. Burland: *American Indian Map Makers*, *Geogr. Mag.*, Vol. 20, 1947-1948, pp. 285-292.

¹¹⁶ Paul S. Martin, George I. Quimby, and Donald Collier: *Indians before Columbus: Twenty Thousand Years of North American History Revealed by Archeology*. xxiii and 582 pp. The University of Chicago Press, Chicago, 1947. \$6.00.

¹¹⁷ Edgar McInnis: *Canada: A Political and Social History*. xvi and 574 pp. Rinehart & Co., New York and Toronto, 1947. \$4.25.

that geographers will enjoy more, and probably learn more from, A. R. M. Lower's "Colony to Nation,"¹¹⁸ which gives a most original and provocative, if opinionated, reading of Canadian history while still indicating loyalty to the Shortt-Doughty-Innis tradition of economic historiography in Canada. Lower eschews the traditional prefatorial physical setting, but he works the rain, the rocks, and the rivers into the warp and woof of his interpretative and descriptive writing in every chapter. Possibly most important to historical geographers is his full and lively treatment of the individual groups in the floods of settlers—their character, their skills, their prejudices. It is, perhaps, unfortunate that the late Ralph Brown's fine collection of studies of the historical geography of North America should be called "Historical Geography of the United States";¹¹⁹ for there are some most useful bits on Canada, particularly French settlement, the fur trade, and the advance of the frontier.

Of regional material on historical geography, or of special interest to historical geographers, there are, in the main, but a few scraps and snippets. For maritime Canada, the region the reviewer knows best, W. R. Bird, historian of the Cumberland County Yorkshiresmen of Nova Scotia, has continued his writings about that group.¹²⁰ Mrs. Esther Wright¹²¹ has written excellent accounts of the Petitcodiac Valley and the Chignecto isthmus area, and the Champlain Society has published a useful primary source in the diary, 1766-1780, of a New Englander who settled on the southwest coast of Nova Scotia (Liverpool).¹²² H. A. Innis' introduction and editorial notes are in his usual terse, meaty style. The diary contains constant references to farming, lumbering, transportation problems, imports of food, and arrival of settlers; it is, indeed, packed with just the kind of information historical geographers often spend fruitless days searching for in the archives. For central Canada, J. W. Watson¹²³ has added three works on the Niagara peninsula to earlier publications about that area.

Much has been published in the postwar period on early exploration,¹²⁴ though with

¹¹⁸ A. R. M. Lower: *From Colony to Nation: A History of Canada*. xiii and 600 pp. Longmans, Green & Co., Toronto, 1946. \$5.00.

¹¹⁹ Ralph H. Brown: *Historical Geography of the United States*. Under the editorship of J. Russell Whitaker. viii and 596 pp. Harcourt, Brace & Co., New York, 1948. \$7.50 (text edit., \$5.50). (See also the review by Lawrence Henry Gipson, *Geogr. Rev.*, Vol. 38, 1948, pp. 508-509.) The Canadian seaboard is also dealt with in Professor Brown's "Mirror for Americans: Likeness of the Eastern Seaboard, 1810." xxxii and 312 pp. *Amer. Geogr. Soc. Special Publ. No. 27*, 1943.

¹²⁰ See especially "When Yorkshire Came to Nova Scotia," *Dalhousie Rev.*, Vol. 27, 1947-1948, pp. 415-423.

¹²¹ Esther Clark Wright: *The Petitcodiac: A Study of the New Brunswick River and of the People Who Settled Along It*. v and 76 pp. The Tribune Press, Sackville, N. B. [1946]. \$1.25.

Idem: *Cumberland Township: A Focal Point of Early Settlement on the Bay of Fundy*, *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 27-32.

¹²² Harold A. Innis, edit.: *The Diary of Simeon Perkins, 1766-1780*. xxxiv and 298 pp. *Publs. Champlain Soc. No. 29*, Toronto, 1948.

¹²³ J. W. Watson: *The Changing Industrial Pattern of the Niagara Peninsula: A Study in Historical Geography*, *Ontario Hist. Soc. Papers and Records*, Vol. 37, 1945, pp. 49-58.

Idem: *Mapping a Hundred Years of Change in the Niagara Peninsula*, *Canadian Geogr. Journ.*, Vol. 32, 1946, pp. 266-283.

Idem: *The Influence of the Frontier on Niagara Settlements*, *Geogr. Rev.*, Vol. 38, 1948, pp. 113-119.

¹²⁴ Note, for example, Morris Bishop: *Champlain: The Life of Fortitude*. vii, 364, and vii pp. Alfred A. Knopf, New York, 1948. \$4.00.

M. Constantin-Weyer: *La Verendrye*. 134 pp. Ducharme, Montreal, 1947.

Also, the *Canadian Alpine Journal* has been publishing since 1945 (Vol. 29, No. 1, 1944-1945) a series on "Early Explorers of the West" by the late Mrs. Elizabeth Parker.

little in the way of new facts or really new interpretations. V. W. Whillans' notes on the diary of Henry Kelsey¹²⁵ will interest students of the historical geography of the prairies. For that region, however, F. G. Roe's further dismemberment of Macoun's reputation is likely to prove not only the most interesting but the most useful publication.¹²⁶ Macoun was the botanist who attacked Palliser's northern parkland route for the Canadian Pacific Railway and was at least partly responsible for its final southern location. For the farthest west, Sage¹²⁷ gives a readable and informative review of the later stages of the negotiations for the settlement of the Oregon Country boundary question. Several works on the history of the Hudson's Bay Company¹²⁸ are supplemented by one more of the few writings by geographers, A. K. Botts's study¹²⁹ of man and nature in the territory in which the company operated. Professor Botts writes from the background of detailed field studies in northern Manitoba.

Three short articles mark some advances in toponymical research.¹³⁰ These illustrate one of the many fields of great interest and importance to geography in general that have scarcely been explored, let alone cultivated, in Canada. Not much of an essentially methodological or philosophical nature has appeared either, but this may be a sign more of good sense in avoiding the futile question "Is it geography?" than of immaturity. Those in whom the geographical spirit burns bright will find encouragement for the present and a happy augury for the future of Canadian geography in Kimble's inaugural address at McGill University, "The Craft of the Geographer."¹³¹

¹²⁵ V. W. Whillans: Henry Kelsey and the Canadian Prairies: I, His Discovery and His Diary; II, His Course and His Later Career, *Chambers Journ.*, 1949, pp. 161-163 and 248-250.

¹²⁶ F. G. Roe: Early Opinions on the "Fertile Belt" of Western Canada, *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 131-149.

¹²⁷ Walter N. Sage: The Oregon Treaty of 1846, *Canadian Hist. Rev.*, Vol. 27, 1946, pp. 349-367.

¹²⁸ R. Glover: The Difficulties of the Hudson's Bay Company's Penetration of the West, *Canadian Hist. Rev.*, Vol. 29, 1948, pp. 240-254.

E. E. Rich, edit.: Minutes of the Hudson's Bay Company, 1679-1684. Part 1, 1679-82, xlvii and 378 pp.; Part 2, 1682-84, xlvii and 368 pp. *Publs. Champlain Soc.: Hudson's Bay Company Ser.*, No. 8, Toronto, 1945, and No. 9, 1946. The "Minutes" for 1671-1674 were published as Number 5 of this series, 1942.

L. H. Thorp: Company of Adventurers: The Story of the Hudson's Bay Company. Little, Brown & Co., Boston, 1946.

¹²⁹ Adelbert K. Botts: Geographic Backgrounds of Hudson Bay History, *Social Education*, Vol. 11, 1947, pp. 343-345.

¹³⁰ M. Barbeau: Les plus anciens noms du Saint-Laurent, *Rev. Univ. Laval*, Vol. 3, 1948-1949, pp. 649-657.

A. R. Cameron: Place Names, *Saskatchewan History*, Vol. 1, No. 2, 1948, pp. 23-24.

P. Daviault: Les noms de lieux au Canada, *Trans. Royal Soc. of Canada*, Ser. 3, Vol. 42, 1948, Sect. 1, pp. 43-52.

¹³¹ George H. T. Kimble: The Craft of the Geographer, *Canadian Geogr. Journ.*, Vol. 31, 1945, pp. 257-263. Also published separately by McGill University.

POSTSCRIPT. We have received, unfortunately too late for extended comment, "Types of Farming in Canada," by S. C. Hudson, R. A. Stutt, William Van Vliet, and J. L. Forsyth (83 pp. *Canada Dept. of Agric. Publ. 825 [Farmers Bull. 157]*, 1949). This excellent cooperative study contains a mine of information—in text, maps, tables, and statistical appendix—for agricultural geographers everywhere and for students of Canadian agricultural geography in particular.

TWO AFRICAN INTERNATIONAL SCIENTIFIC CONFERENCES

TH. MONOD

THE success of the two recent scientific conferences in Africa is a great encouragement to those responsible for their promotion at a time when an "act of faith" rather than an "act of reason" was called for. Both meetings provided a survey of work accomplished or in progress, indicated possibilities for future planning, and demonstrated the effectiveness of working from regional bases where the continent in itself is so vast.

THE FIRST AFRICAN REGIONAL SCIENTIFIC CONFERENCE

The first African Regional Scientific Conference met in Johannesburg, October 17 to 28, 1949, on the invitation of the government of the Union of South Africa.¹ More than a hundred delegates attended, the great majority, 88, from the British Commonwealth (United Kingdom, 11; Central Africa, 15; East Africa, 17; West Africa, 7; Basutoland, 1; Swaziland, 1; Union of South Africa, 36); the remainder were distributed among Belgium (8), France (5), and Portugal (10). The Steering Committee was composed as follows: President, Dr. P. J. du Toit (South Africa); leaders of national delegations, Professor A. A. Mendès Correia (Portugal), Sir Ben Lockspeiser (United Kingdom), Professor J. Millot (France), Dr. B. F. J. Schonland (South Africa), and Dr. P. Staner (Belgium); and the chairmen of the sections, which were: Physical Environment, Dr. S. H. Haughton (South Africa); Soils and Plants, Dr. A. Quintanilha (Portugal); Zoology and Animal Industry, Professor L. van den Berghe (Belgium); Health and Medical Research, Sir Edward Mellanby (United Kingdom); Social Research, Professor Th. Monod (French West Africa); Technology, Dr. E. B. Worthington (East Africa).

The plenary sessions were devoted to reports from territorial representatives. Broad in scope, they often touched on geographical matters; for example, the organization and work of the various mapping services. They provided a sort of panoramic view of the status of scientific research in the part of Africa south of the Sahara, and a faithful picture of the scientific resources of the continent. I am not sure, however, that an auditor unfamiliar with the African scene would obtain a very exact idea of the state of things, in particular of the vast disproportion between the resources in personnel, credits, and the like as they are and as they ought to be, between what we do and what ought to be done. Such an official gathering always, and properly so, has a certain air of optimism. It is right for us to consider with sincere satisfaction what has already been accomplished, and we should never be allowed to forget the great efforts to which many have literally dedicated their lives; yet all of this is little enough beside the terrible vastness of a continent that by its very immeasurability discourages investigation.

After the plenary sessions, which constituted the first phase of the Conference, the work proceeded on a dual plan, in the meetings of the sections, where a great number of subjects

¹ The result of a recommendation made at the Commonwealth Scientific Conference, held in London, 1946. See H. B. S. Cooke: *The African Regional Scientific Conference*, *South African Journ. of Sci.*, Vol. 46, 1949-1950, pp. 137-144; reference on p. 137.

were presented, and in those of the Steering Committee, where one of the main objectives of the Conference was discussed in a searching way—the creation of an African Scientific Council.

I have no intention of describing the work of the sections in detail, or the some 120 papers, printed and distributed in advance, or the resolutions adopted. But I do wish to comment briefly on the aspects of particular interest to the geographer. The Johannesburg Conference was not of the usual type in which the papers presented and the discussions that follow have for their purpose exposition of research techniques, results, or problems. It was not a gathering of specialists to discuss matters in their respective fields. Whatever the subject treated, it was from the angle of coordination, of international collaboration, or organization of the range of African researches in progress or to be undertaken. That is the truly unique feature. The Conference was a sort of "council of war" in which the pacific battles of future African research were mapped out. Hearty thanks are due to the Union of South Africa for having taken the initiative and brought together the staff of specialists necessary to the formulation of a scientific strategy.

It is to be hoped that the resolution adopted by the Conference on the creation of a Scientific Council for Africa south of the Sahara will be given speedy consideration by the interested governments. I have myself strongly insisted, in a special report,² on the necessity of laying the "roof" of an African Scientific Council only on the pre-existing "walls" of the solid regional organization of a territory too vast for any single scientific capital to be chosen at this time. Thus I am the more free to accept unreservedly the principle of such a Council, which is eminently satisfactory both from the international point of view and from that of the research workers of the several governments.

I am not ignoring, be it understood, the insoluble problems that will inevitably arise in connection with any project for the regional division of Africa. The scheme that I have offered, if not the best, seems reasonable. If certain territories feel themselves injured by such a division, the fault, alas, lies in their geographical situation, in the extreme rigidity of the African framework, which cannot be remedied for a long time.

We turn now to the work of the Conference. Among the papers of special geographical interest were reports on the use of air photographs and air survey for scientific purposes; the need for special maps of African subregions, giving detailed information necessary for scientific assessment and planning of development; the Directorate of Colonial Surveys; the cartography of Madagascar; the basic geophysical problems of Africa; the collection of geodetic data and its application to various scientific uses; terrestrial magnetism, observations and activities in East Africa; meteorological research in Africa; climatology in relation to land use in general and with special reference to the influence of climate on fruit growing; radio meteorology in South Africa; the water cycle as affected by land use; the international atlas of West Africa; soil conservation in Africa, with special reference to the Goma Conference; soil classification, mapping, and soil survey in South Africa; some soil and conservation problems of continent-wide significance; the organization of soil surveys in British East Africa; plant geography in South Africa; the influence of the physical environment of Africa on the health of the human population; housing in hot climates.

Some of the resolutions adopted by the Conference for the section on physical environment related to the following:

² Th. Monod: *L'importance des aspects régionaux dans la recherche africaine*, African Regional Scientific Conference, Johannesburg, 1949, Communication No. G(s) 4.

1. Intensification of international meteorological collaboration under the aegis of the Regional African Commission of the International Meteorological Organization; preparation of a climatological atlas of Africa; compilation of an African meteorological bibliography; establishment of a system of interterritorial meteorological exchange.

2. Projects designed to perfect the geophysical equipment and to ensure the desired international liaisons in the fields of seismology, magnetic, ionospheric, and gravimetric observation, and the like.

3. The development of hydrological studies of prime importance to the water problem in so many African regions—river discharge, ground water, infiltration, evaporation, and so on.

4. Advancement of aerial photography, which is at last considered by government to be an "essential service," to the point of complete territorial coverage, to be followed by systematic revision at 10-year intervals.

5. The furtherance of a cartographic system adopting uniformity in the "figure of the earth" used in projections, division of the map sheets, scales, conventional symbols, place names and orthography, and units of measurement.

I am particularly pleased to report that after a statement by Dr. Worthington, which I had the privilege of supporting, the following recommendation was made:

The Conference recognizes the need for compiling and comparing in the form of maps a large number of facts of importance for progress in scientific research and in the economic development of Africa. This objective is not usually included among those of cartography and topography.

The facts need to be collected, collated, and made available in the form of small-scale maps directly comparable with one another.

The Conference recommends that each main region in Africa arrange for the production of such maps or atlases, with interstate collaboration where necessary. These maps should provide information on the following subjects, among others: (a) physical environment (geology, climatology, hydrology, etc.); (b) biological environment (vegetation, fauna, insects as vectors of disease); (c) human facts (races, pathology, demography, ethnic groups, languages, communications, economic factors, etc.). The work should, if possible, be co-ordinated so that the maps provide a uniform atlas of Africa.

It was natural—and indeed almost inevitable—that the Johannesburg Conference, dealing with the organization of scientific research over an immense continent and wishing, as far as possible, to forget the artificial political compartmentation brought about by the accidents of history and conquest, should think of its problems largely in terms of geography; that is to say, in terms of intelligent synthesis, seeking to bring each part into harmony with the greatest possible number of causal factors—physical, biological, and human. To insist on the interdependence of things and beings is always and everywhere to serve the cause of geography rightly understood.

THE THIRD WEST AFRICAN INTERNATIONAL SCIENTIFIC CONFERENCE

In 1945 the Institut Français d'Afrique Noire took the initiative in calling together the first West African Scientific Conference. It met in Dakar and proved successful, and a second conference was held at Bissau, Portuguese Guinea, in 1947. The third conference was held

in Ibadan, Nigeria, in 1949, and a fourth is scheduled for 1951, to be organized by the Spanish African colony of Fernando Po and Continental Guinea.

The third conference met December 12 to 21. Its officers were: President, Dr. Kenneth Mellanby, principal of the University College of West Africa, Ibadan; Vice-presidents: Professor Daryll Forde, London; F. Hernandez-Pacheco, Madrid; Th. Monod, Dakar; Secretaries-General: B. E. B. Fagg, Government Archeologist, and K. C. Murray, Surveyor of Antiquities.

The business of the Conference was conducted in three sections, concerned with the physical, biological, and human environments.

Papers of interest dealt with the geological uses of air survey, with particular reference to the Nigerian tin fields; types of native agriculture seen in an aerial traverse; an ecological map of the vegetation cover of the Thiès sheet, Senegal; ethnic and demographic maps of the region extending from the Greenwich meridian to 4° E. and from the coast to the desert; the zoogeography of Nigerian mammals; land settlement and tenure in Ibadan and land tenure in Lagos; the origin, classification, and distribution of Nigerian laterites; Quaternary climatic variations in Senegal; physiological classification of climates, illustrated from Nigeria; a provisional classification of erosion surfaces in the environs of Brazzaville and erosion surfaces on the Jos Plateau; a stratigraphic sketch of the Blue Mountains region, Ivory Coast, and its paleoclimatic and paleogeographic significance; prehistoric contacts between the Mediterranean world and tropical West Africa. A special plenary session was devoted to the International Atlas of West Africa. On behalf of J. Richard-Molard, head of the geographical section of the Institut Français d'Afrique Noire, I reported on its progress and presented the drafts of a number of sheets—geology, population density, rainfall, etc.—and led a general discussion on the best way of effecting the needed international collaboration.

A series of excursions enabled the delegates to profit by their short stay in Nigeria. These included one of physiographic and geological interest to the Jos Plateau, led by Drs. J. C. Pugh and J. W. du Preez, on which were examined the ancient basement complex, the younger granites, and the fluviovolcanic and recent lava flows, and on which the problem of the various erosion surfaces claimed particular attention.

THE AMERICAN GEOGRAPHICAL SOCIETY

The Isaiah Bowman Memorial

The American Geographical Society announces with gratitude and satisfaction the establishment by Mr. Archer M. Huntington, a member of its Council and former President, of a permanent trust fund of one hundred thousand dollars, to be known as the Isaiah Bowman Memorial, the income of which is to be used for such purposes as the Council from time to time may deem most fitting.

At its meeting held on February 15, 1950, the Council of the Society decided to use the greater part of the income from the fund for the purpose of instituting a series of lectures to be delivered at intervals by distinguished geographers, each series to be subsequently published in book form. It is hoped that the first series will be delivered during the winter of 1950-1951. In addition, to the extent that income provides, a research fellowship is to be offered for work in the geographical field. Both the lectureship and the fellowship will bear the name of the man they honor.

Resolution of the Council

At the meeting of the Council on February 15, 1950, a resolution in tribute to Isaiah Bowman was unanimously adopted (see pp. 175-176). An appreciation of Dr. Bowman's contributions to the field of geography will appear in a forthcoming issue of the *Geographical Review*.

The Society's Lectures

The second Regular Meeting of the season was held on January 17, 1950, Mr. Woodfin L. Butte, member of the Council, in the chair. Mr. Charles Allmon talked "Of Shores and Sails in the South Seas," describing the life and customs of the people of Tahiti and the Polynesian islands against the backdrop of a modern world, and showed an unusually beautiful colored motion-picture record of his travels.

On January 31, Dr. Jacques M. May, head of the Society's Department of Medical Geography, gave the second Special Lecture of the season, "Medical Geography: Its Objectives and Methods," in which he outlined some of the problems and discussed possible and actual correlations between pathological and geographical factors. Mr. R. McAllister Lloyd, Treasurer of the Society, presided.

At the Regular Meeting held on February 21, Mr. Butte again in the chair, Mr. Cleveland P. Grant, well-known naturalist, gave a talk on "North to the Yukon." The colored motion picture taken by Mr. and Mrs. Grant, showed the scenery, wildlife, and many points of historical and current interest along the Alaska Highway, at the headwaters of the Yukon River, and in Alaska.

At the Special Meeting on March 7, Dr. Trevor Lloyd, chairman of the Department of Geography at Dartmouth College, spoke on "The Postwar Reconstruction of Northern Norway," reporting on his journey in 1949 through Finnmark and describing the changes brought about by the Nazis in 1944-1945 and the subsequent reconstruction. Mr. Charles B. Hitchcock, Acting Director, presided.

Informal Talks

On January 12, M. Paul-Emile Victor, director of the Expéditions Polaires Françaises, gave an informal talk at the Society's building for the staff and a few guests on "The French Expeditions to Greenland 1948-1950." His report on the work of the group, which has established a station near the middle of the icecap, was accompanied by a colorful and informative film. On January 27, Dr. John K. Wright, former Director of the Society, spoke on some of the more important events, trends, and personalities of its first decades. Dr. Wright is currently at work on a history of the Society. On February 17, Mr. Maynard M. Miller, research assistant in glaciology on the Society's staff, showed a colored film record of the Society's field studies in Patagonia in 1949 and gave an account of his trip with Dr. Robert L. Nichols to study glacial and geomorphological features in Argentine Patagonia in cooperation with the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" of Buenos Aires.

Revised Sheets of the Millionth Map

Revised editions of two sheets of the Society's Map of Hispanic America, 1:1,000,000, have been issued, São Luiz (South A-23) and Fortaleza (South A-24).

ANNUAL REPORT OF THE COUNCIL

February 15, 1950

To the Fellows of the Society:

The following report prepared by the Acting Director on the activities of the Society for the year 1949 is published by order of the Council.

RICHARD U. LIGHT
President

To the Council of the Society:

The year 1949 was marked by important changes in the Society's staff. Dr. John K. Wright, Director since 1938, resigned from his administrative duties on July 1 to return to the field of research. On December 6, Dr. George H. T. Kimble, Chairman of the Department of Geography at McGill University in Montreal, received and accepted the appointment as Director; he will assume the responsibilities of administration in June. Dr. Gladys M. Wrigley retired as editor of the *Geographical Review*, a post she has filled ably and with scholarly wisdom for the past 29 years. Wilma B. Fairchild, a member of the staff since 1938, assumed the editorship in June, and the October issue of the *Review*, her first, augurs well for the future. Fortunately, both Dr. Wright and Dr. Wrigley will continue to take part in the Society's work, the former in the preparation of a history of the Society and the development of geography over the past hundred years, and the latter as editorial adviser on the *Review* and valued collaborator in many phases of our program.

Research activities continued, both in the building and in the field. The progress of this work has required the conscientious efforts of the staff, the sustained and interested support of our Fellows, the financial aid received through contractual arrangements, and outright grants for projects that the Society is particularly well equipped to carry out. Unfortunately, in recent years it has been necessary to make inroads on our capital in order to maintain the tempo of activities. The library and map collection with their specialized staffs, the business office, the building itself—these are essential for the continuance of the comprehensive program on which we have been engaged for 35 years. Yet they do not pay their own

way and must be carried by membership dues, overhead charges derived from specific projects, income from endowment, and gifts from interested friends.

Two of our objectives are "to collect and disseminate geographical information by discussion, lectures, and publications" and to promote "studies relating to questions of wide public interest." The first implies the maintenance not only of the library, the map collection, and the lecture series but also of the intensive publication program so successfully carried on for more than a quarter of a century. The second, aside from its intrinsic worth, is the means whereby the Society maintains contact with current events and keeps abreast of technical advances in many fields.

We realize the seriousness of our present financial situation, a condition that is shared by many nonprofit research institutions and universities at this time. An expanded membership would go far toward preventing retreat to middle ground and permit not only continuance of our existing programs but development of new activities. In this critical period in the Society's life, with new direction forthcoming and a drive for funds inevitable if we are to maintain and improve our *status quo*, the full support of our membership is essential.

THE GEOGRAPHICAL REVIEW

Although the editorship of the *Geographical Review* is in new hands, no essential change in character or policy is at present under contemplation. "Geographical Interpretation" in the sense defined by Isaiah Bowman in the July issue remains a prime objective. We seek, for instance, to illustrate the necessity for geographical studies in planning policies for resource use in water developments in Central Africa, in a vegetation-types map of Tanganyika Territory, in fisheries development in South Africa and Japan, in the settlement of China's far west and Argentina's far south. We are aware of the importance of change and its increasing tempo, in the sense of time as well as of place—in the crescendo of change in the Belgian Congo, for instance. We take a backward look at New Zealand at the time of Cook's voyages and a forward look at the future of the eastern Carolines. We trace emerging patterns in social geography as diverse as the growth of the city of Dublin and the place of the Asiatic community in South Africa. We combine with other sciences in the conquest of environmental problems; for instance, the production of clothing for global man.

Some light on the behind-the-scenes work on the *Geographical Review* has already been given our readers in the new features, the Foreword and the Editorial, introduced in 1948. We have had something to say on the early establishment of the Society, now nearing its centenary, on the great value of its library and map collection, on the width and breadth of its contacts. All these are obvious assets. There are other, "hidden assets" of which the retiring editor would like to make acknowledgment—the Society's staff in general. Most particularly we have been indebted to Stanley F. Smith, the *Review* cartographer, whose death in May of last year was so severe a loss, and to E. D. Weldon, Gustav Schweizer, John Forsyth, and John Philip of the Society's cartographic staff, who are helping out pending a new appointment to that position; Marion Hale, devoted secretary, who has all the details at her finger tips; Marion L. Eckert, incomparable proofreader and "severest critic," who far transcends the ordinary duties of her office. The *Review* is happy also in its printer, Ben Lane of Burlington, Vt., and its printing consultant, George R. Grady of New York City, and in John J. Sheridan and Clifford J. Moore of the Phoenix Engraving Company of New York City, all of whom show deep personal interest in the production problems of the *Review* and its emergencies. To meet the exigencies of regular periodical publication is not easy. There are

many links in the chain; we have been fortunate in maintaining them throughout the years.

LIBRARY AND MAP DEPARTMENT

During the year 746 books, 518 pamphlets, 1898 complete volumes of periodicals (6533 parts), 23,183 maps, 171 atlases, and 1118 photographs were added to the collections, which now total 124,877 volumes of books and periodicals, 25,105 pamphlets, 197,931 maps, 2774 atlases, and 33,582 photographs. To the various catalogues 17,222 cards were added. The number of consultants using the collections showed a substantial increase over 1948.

The essential research materials are obtained primarily through gift and exchange. In 1949, 99.4 per cent of the maps received, 72 per cent of the books and pamphlets, and 27 per cent of the periodicals were gifts, and 45 per cent of the periodicals were exchanges. Government agencies, commercial firms, universities, scientific institutions, and private individuals, both in the United States and abroad, have thus helped to make possible the continued growth of the collections, and we extend our gratitude for their generous support.

Volume 12 of *Current Geographical Publications* was completed. Annotated references were supplied, as in previous years, to the Association de Géographes Français for the *Bibliographie Géographique Internationale*. A member of the library staff contributed the commentary on travel books to the *American Year Book*. The library staff also collaborated in checking and supplying titles for the "Union List of Serials" and "A Comprehensive Checklist of Serials of Geographic Value." The Society is likewise collaborating with the Columbia University Press in the preparation of the Columbia-Lippincott Gazetteer, and extensive use of our collections has been made by the staff of that project.

NEW BOOKS

A special edition of "Acclimatization in the Andes" by Dr. Carlos Monge was made available for distribution by the Society through the courtesy of The Johns Hopkins Press. The fact that this was the only new book distributed during the year is not to be taken as an indication that our editorial staff has not been actively engaged. The text of "World Geography of Petroleum," a collaborative study by twenty distinguished authorities, edited by Wallace E. Pratt, eminent petroleum geologist, and Dorothy Good of the Society's staff, was completed; the book will be published for the Society by the Princeton University Press in 1950. "A German and English Glossary of Geographical Terms" by Eric Fischer and Francis E. Elliott has been prepared for press by Anastasia Van Burkalow and is now in galley proof. Editorial work is well advanced on a third book, "Europe: Land, Life, and Livelihood."

In 1923 the Society published the first edition of the "New York Walk Book," an illustrated guide to walking trips within easy distance of New York City. The New York-New Jersey Trail Conference is now cooperating with the Society in the preparation of a new edition. The first draft of the text was completed during the year by a committee of the Trail Conference under the chairmanship of Mr. Ridsdale Ellis, and editorial work is now in progress at the Society.

CARTOGRAPHY

The cartographic staff, under contractual arrangements with the Army Map Service, Washington, D. C., issued seven completely revised sheets of the Map of Hispanic America, 1 : 1,000,000: Río Mira-Islas Galápagos (North A-17), Cayenne (North B-22), Quito (South

A-17), Iquitos (South A-18), Pará (South A-22), Teresina (South B-23), and Paraíba (South B-25).

Compilation and final drafting of five additional sheets were well advanced during the year: Roraima (North B-20), Barranquilla (North C-18), São Luiz (South A-23), Fortaleza (South A-24), and Jaguaribe (South B-24). The mere listing of these titles does not, perhaps, convey the considerable amount of research, assembly, skilled cartographic art, and reproduction knowledge required to produce the sheets. So far as outlay of effort and money is concerned, each may be considered the equivalent of a small book; in fact, several sheets, Barranquilla in particular, would, correspondingly, reach the proportions of a sizable volume. To Mr. A. B. Hoen of A. Hoen and Company, Baltimore, who has maintained an active watch over the reproduction aspects of the project from its inception in the early 1920's, we are greatly indebted.

Compilations for a series of topographical sheets to be included in the new edition of the "New York Walk Book" were prepared, and initial work on a new map showing certain aspects of the world distribution of poliomyelitis was undertaken for the medical-geography program.

MEDICAL GEOGRAPHY

A grant of \$15,000 from the Upjohn Company, Kalamazoo, Mich., permitted the initiation in November, 1948, of a program of studies in medical geography under the direction of Dr. Jacques M. May. In November, 1949, the Upjohn Company made a second grant for the same amount; continuance of this new project for another year is thus assured. One of the first problems confronting its director was to define the scope and objectives of medical geography and outline a definite program of future research. An article on the general problem was prepared by him for publication in the January, 1950, number of the *Geographical Review*. Three phases of the program are now in progress: (1) the investigation of the problems related to the world distribution of a specific disease, cholera; (2) the study of the pathological aspects of a specific region, the Caribbean; and (3) the preparation of a world Atlas of Diseases.

1. A bibliography of more than 500 references (books, papers, and maps) for the pilot study of cholera has been gathered and analyzed. Preliminary research has shown that an understanding of the factors governing the endemicity of the disease is the most important problem pertaining to its ecology. This implies careful studies in the field. Negotiations have been carried out with the World Health Organization, and the findings of that agency's studies now in progress in India will be made available to the Society. The results are to be presented as a historical and geographical atlas of cholera.

2. The present distribution of disease is only surmised from the pattern emerging from the notification of known cases. No adequate studies of geomedical correlations can be made until our knowledge of distribution is considerably increased. This can only be brought about if a new system is worked out that will convey an accurate picture of "who" has "what" and "where." After consultation with the Statistical Division of the United Nations we have outlined a new approach based on sample studies of populations. The Pan American Sanitary Bureau and the Puerto Rican government have been consulted and have indicated their interest. It is hoped that the technique can be put to a test in Puerto Rico and that from these sample studies a more definite picture of the diseases prevalent in the territory may be worked out. If this undertaking should prove successful, an important step forward

will have been made toward our knowledge of the distribution of disease in general.

3. The proposal of an atlas of diseases has met with the approval of the Steering Committee and other scientists. A questionnaire was sent to 150 health agencies throughout the world, asking them to furnish data for the past three years on fifty of the most important diseases, and eighty-four answers have so far been received and tabulated. Poliomyelitis has been selected as the subject of the first map. Medical data have been compiled, and the map is now in preparation; an article discussing various aspects of the geographical distribution of the disease will accompany the map. Relations have been established with the International Union against Cancer and the National Cancer Institute, and a plan for an investigation of the world distribution of cancer is now being prepared. It is hoped that a map showing the prevalence of the various types of cancer will result from these studies. This would be the first map of its kind, and it is probable that when the distribution of cancer is revealed, new light will be shed on this mysterious problem.

GLACIER STUDIES

The Glacier Study Program under the direction of W. O. Field, Jr., has been carried on according to plan. The major activity was the second season of field work of the Juneau Ice Field Research Project.

The field work, made possible by funds and equipment provided by several government agencies, embraced both high- and low-level studies. The personnel comprised four botanists, three geophysicists, three meteorologists, five geologist-glaciologists, one doctor and a medical assistant, two surveyors, one photographer, one radio expert, and three general assistants; an account of the work and its results will appear in the April, 1950, number of the *Geographical Review*. [See pp. 179-190.]

A second undertaking in 1949 was the initiation of glaciological and geomorphological studies in Argentine Patagonia. Dr. Robert L. Nichols, professor of geology at Tufts College, and Maynard M. Miller of the Society's staff joined in a cooperative venture with the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" in Buenos Aires. Studies were made in the Lago Argentino area and at localities farther north. It is hoped that these studies may be continued another year and be extended to parts of the Andes in Chile and Peru.

A third undertaking was the second season of observations by W. O. Field, Jr., among the glaciers of the Columbia Ice Field area in the Canadian Rockies. The report of the 1948 work was published in the *Canadian Alpine Journal* (Vol. 32, 1949, pp. 99-114) under the title "Glacier Observations in the Canadian Rockies, 1948."

Although the attention of the Department of Exploration and Field Research was devoted chiefly to administering the first two of these projects, progress was made in building up its collections of photographs, maps, and records pertaining to glacier variations in North America. Its office served as headquarters of the Committee on Glaciers of the Section of Hydrology, American Geophysical Union, and the department, in addition to keeping up the committee's files of photographs and data, performed various organizational and coordinating functions. Increasingly close relations were maintained with groups concerned with glaciology in other countries.

On January 19, 1949, the Society and the Arctic Institute of North America, whose New York office is in the Society's building, jointly sponsored a glaciological conference. Twenty-three persons attended, including representatives of a number of universities and government agencies.

OTHER RESEARCH ACTIVITIES

Dr. Wright began work in June on a history of the Society and of American geography as illustrated in its publications. He will welcome any information on the subject that Fellows or others may care to send him. This project was initiated in 1946 when Saul Benison, then a graduate student in American history at Columbia University and now of Sarah Lawrence College, was engaged by the Society to compile extensive notes on the period before 1900.

O. M. Miller has completed approximately half of the first draft of a book on "Reconnaissance Mapping from Aerial Photographs: A General Introduction to Photogrammetry."

Raye R. Platt has resumed work, suspended during the war, on a volume describing the Society's Map of Hispanic America, 1 : 1,000,000. The book will also include sections on various aspects of the development of cartography in Latin America.

Charles B. Hitchcock participated for the third successive year in an expedition to southeastern Venezuela at the invitation of the expedition's organizer and leader, William H. Phelps, Jr., of Caracas. This year a previously unexplored mountain area east of the Ventuari River was visited. Ornithological and botanical collections were made, geographical and geological observations recorded, and a reconnaissance map constructed.

COLLABORATION IN OTHER ENTERPRISES

Members of the staff continued to participate actively in the work of other organizations. Dr. John K. Wright represented the Society at the Lisbon Congress of the International Geographical Union in April, where he was made chairman of the Commission on the International Map of the World, 1 : 1,000,000. He was also made chairman of the Publications Committee of the United States for the International Geographical Congress to be held in 1952 and served as a member of the Centennial Studies and National Atlas Committees of the Association of American Geographers and of the Committee on Research of the Arctic Institute of North America. Raye R. Platt was a member of the Council of the American Association for the Advancement of Science and the Society's representative on the Inter-Society Committee for a National Science Foundation. O. M. Miller continued as chairman of the Committee on Map Sketching from Aerial Photographs in the Division of Geology and Geography, National Research Council; served on the Advisory Council of the Department of Civil Engineering, Princeton University; directed and edited the first ten-year index of *Photogrammetric Engineering*; and served on the Board of Direction of the American Congress on Surveying and Mapping. The Society's Librarian, Nordis Felland, attended the International Geographical Congress in Lisbon, after which she visited a number of European geographical societies and institutions. She served as secretary of the New York Group of the Society of Woman Geographers, and as vice-chairman of the Geography and Map Group of the New York Chapter of the Special Libraries Association. The Society's Map Curator, Ena L. Yonge, attended the meeting of the Special Libraries Association in Los Angeles in June, where she acted as chairman of the Geography and Map Group. She also served as treasurer of the New York Metropolitan Division of the Association of American Geographers. W. O. Field, Jr., represented the Society in the Division of Geology and Geography, National Research Council, and acted as chairman of the Committee on Glaciers, Section of Hydrology, American Geophysical Union. Dr. Jacques M. May, director of the Society's studies in medical geography, was elected chairman of the Commission on Medical Geography of the International Geographical Union and gave lectures on medical geography at New York University and The Johns Hopkins University. C. B. Hitchcock continued as

treasurer of the Association of American Geographers and chairman of the United States Advisory Committee on American Cartography and served on a panel of the Research and Development Board of the National Military Establishment and on a Committee on Latin American Geography of the National Research Council.

LECTURE PROGRAM

The program of a dual lecture series, begun in 1948, was continued. The four regular meetings (formerly designated Series A) comprised lectures by Mr. Walter A. Wood on "Project 'Snow Cornice,'" January 18; Mr. William Vogt on "The Geography of Conservation," February 15; Mr. Karl Robinson on "China Journey," March 15; and Dr. Robert Cushman Murphy on "A Naturalist in Changing New Zealand," November 15.

The special meetings (formerly Series B), of a more technical nature and directed primarily to Fellows with a scientific or professional interest in geography, were also four in number: Professor E. Estyn Evans spoke on "Northern Ireland: The Land and the People," February 1; Professor Lester E. Klimm on "What Is Modern Geography?" March 1; Professor Edward Ullman on "The Railroad Pattern of the United States," March 29; and Mr. Maynard M. Miller on "Glacier Studies in Alaska and Patagonia," December 6.

During the year a number of informal talks were given at the Society's building for members of the staff. On May 20, Mr. William H. Phelps, Jr., of Caracas, showed a motion picture of his 1949 expedition to Serranía Parú in the Venezuelan Guayana; on September 30, Dr. John K. Wright and Miss Nordis Felland gave an account of their participation in the Lisbon meeting of the International Geographical Union; on October 3, Dr. Thomas C. Poulter described geophysical methods used in the determination of ice thickness in Alaska during the 1949 field season of the Society's Juneau Ice Field Research Project.

FELLOWS

The number of Fellows on December 31 (including persons who had signified their desire to join but were still awaiting formal election) was 4569, of whom 11 were Benefactors, 7 Patrons, 169 Life Fellows, and 51 Sustaining Fellows.

CHARLES B. HITCHCOCK
Acting Director

ELECTION OF OFFICERS AND COUNCILORS

At the meeting of the Council held on February 15, 1950, the following-named gentlemen, recommended by the Nominating Committee, consisting of Messrs. Carlisle, chairman, Butte, and Ingersoll, were elected to the offices designated:

For officers until the Annual Meeting in 1951:

<i>President</i>	Richard U. Light
<i>Vice-President</i>	William Hale Harkness
<i>Vice-President</i>	William A. Rockefeller
<i>Vice-President</i>	J. Clawson Roop
<i>Acting Secretary</i>	Charles B. Hitchcock
<i>Treasurer</i>	R. McAllister Lloyd

For members of the Council until 1953:

Roland L. Redmond

J. Clawson Roop

GEOGRAPHICAL RECORD

NORTH AMERICA

THE QUETICO-SUPERIOR AREA. "A Geologist Looks at the Quetico-Superior Area" by Wallace W. Atwood (*Canadian Geogr. Journ.*, Vol. 39, 1949, pp. 36-43) may well be termed the "swan song" of the famous geographer, for he himself passed into history shortly after the article appeared.

Observations on the geology were made from the air by crossing back and forth over the 16,000 square miles. About 40 per cent of the surface is occupied by lakes. The surface rocks are pre-Cambrian remnants of ancient erosion cycles that reduced higher elevations to a monotonous peneplain. Subsequent uplift gave streams cutting power. During Pleistocene time preglacial valleys were obliterated. At present streams lack the pattern of typical river systems but seem to flow on floors of old lake basins or in joint plains scoured out by glacial ice. Dr. Atwood suggests the possibility that similar drainage conditions exist in most of the Canadian Shield, and perhaps even in Finland and other northern European countries. In the Quetico-Superior wilderness the rivers are characterized by rapids and waterfalls, lakes are at various levels, and drainage routes are "a tangle of streams." The topography is evidently the result of glacial activity. The ice gouged out holes in the rocks that range from shallow basins to depressions holding lakes several hundred feet in depth.

Beautiful photographs present the charm of the topography and the geological formations. In the concluding paragraph Atwood the conservationist speaks with feeling of the effort being made to preserve "unharmed, for posterity, some of the places in the natural landscape of unusual charm and of scientific, educational and spiritual significance." President Truman's recent executive order closing the Superior National Forest to air traffic, both private and commercial, is a welcome forward step in this direction.—J. E. POTZGER

WEATHER AND CLIMATE OF WASHINGTON, D. C. During the war graphic analyses of the climatic characteristics of various localities in the theaters of war proved useful in the planning of military operations. In the belief that "this method of organization of climatological data could serve many useful peacetime purposes," the U. S. Weather Bureau has issued, as a demonstration of the possibilities, a comprehensive assemblage of data on the weather and climate of Washington, D. C., 1871-1945 (*The Climatic Handbook for Washington, D. C., U. S. Weather Bur. Tech. Paper No. 8, 1949*).

Tables, of which there are 137, "summarize averages and extremes, as well as present frequency distributions of the various meteorological elements"—such as temperature, precipitation, sky cover and sunshine, wind, humidity, pressure, and upper air data. In the 87 pages of charts there are "diagrams and maps which show annual, seasonal, and diurnal variations; the relations of two or more meteorological elements; and the weather associated with selected meteorological conditions at Washington." A very useful type of chart often presented is the "expectancy diagram," which shows for each month or season the greatest and least events recorded and the "most likely range," that is, the "smallest range which includes at least 50 percent of the events in the period of record." Such diagrams reveal clearly, for example, that the maximum variability of temperature occurs in winter, when both the absolute range of average temperatures and the most likely range are at their great-

est. In the case of precipitation, however, summer is the season of greatest variability, both in terms of absolute range and most likely range of total precipitation.

There is a brief text in two parts. The first describes the tables and charts; the second deals with "Unusual and Noteworthy Meteorological Events at Washington, D. C.," events outstanding because of their duration or their intensity. Tables do not always reveal the actual significance of such events and never reveal their effects on life and property. "It is these effects of meteorological extreme conditions that a planner, designer, or operator must consider when he estimates the importance of weather on his activities and plans. In this section an effort is made to show the effects that extreme weather conditions can cause on human activity in this locality."

Additional climatic handbooks of this type for other parts of the country would do much to improve our understanding of local weather and climate and to make our knowledge readily available for application to practical problems.

THE AMERICAN SYSTEM OF SOIL CLASSIFICATION. In February, 1949, there appeared in *Soil Science* a group of papers, introduced by Charles E. Kellogg, that put forward in a modest but courageous manner the present views of the Soil Survey Division of the United States Department of Agriculture.

The existing knowledge has a reliable foundation. C. F. Marbut described (1921-1922) ten features that ensure identification of a soil; they are, as it were, its ten fingerprints. T. M. Bushnell used (1932) air photographs as base maps and as an aid in finding and mapping boundaries between different soils. These two contributions made possible the rapid, detailed, and unequivocal mapping of comparatively small areas of land—areas ranging from a farm to a county. On such maps the different kinds of soil receive local names. "Miami silt loam," for instance, is the name of a *soil type*; that is, it is the name of a particular kind of soil that has been carefully examined and described and that can be recognized by inspection in the field (F. F. Riecken and Guy D. Smith). But the farmer needs a little further information; this is supplied by adding certain approved adjectival expressions, indicating either slope or erosion or stoniness. We may have, for example, "Miami silt loam, eroded phase." The soil types and phases are delineated on the map; they are the units from which the map is made. Establishment of these lower categories has permitted the making of detailed and accurate soil maps of great value for local needs. C. P. Barnes gives a good introduction to four papers describing the various uses of maps thus constructed.

Difficulties arise and uncertainty increases as local information of this kind accumulates. The situation is well described by J. Kenneth Ableiter in the final paper of the symposium. Attention may be particularly directed to his remarks on "present trends," "imperfections due to changing concepts," and "some research needs."

In making maps of larger areas it is neither practicable nor desirable to include all the detailed information that has been collected. A. C. Orvedal, Mark Baldwin, and A. J. Vessel point out that in making a generalized map smooth boundaries are substituted for the original wavy ones, small areas of one kind of soil are included in a different but more extensive kind, new units consisting of *soil associations* or *soil complexes* (Iver J. Nygard and Francis D. Hole) are devised. These soil associations are of different kinds and may include highly diverse kinds of soil. There may be, for example, a catenary association in which a sequence of soils is regularly associated with relief and drainage or an undifferentiated association in which

two soils or more form a pattern that is too intricate for mapping or that has no present economic significance. Because of the decisions involved, the making of such maps is an art rather than a science. Even in the original field surveys there is need for discrimination. J. W. Moon, W. S. Ligon, and J. R. Henderson accordingly note that, to provide the kind and degree of detail needed, the surveyors should keep in mind the purpose of the survey.

Difficulties of another kind arise when one tries to eliminate the strictly local character of the original survey. It may be evident to the eye, and laboratory experiments may confirm, that there is a great similarity between soil type A recognized in one locality and soil type B recognized in another locality. Moreover, such a resemblance would be expected; for we have learned that soils are formed in a somewhat regular way by the operation of climate, topography, plants, and animals on various parent materials. Excellent examples are given in the paper by R. J. Muckenhirn and others. They are rather isolated examples; for we cannot in general disentangle the effects of the various factors at work in soil formation. Nevertheless, classification essays to give expression to the underlying orderliness in the nature and distribution of soils.

Attempts at soil classification have been numerous; none was wholly useless; none is wholly satisfactory. V. V. Dokuchaiev (1879) noted in Russia the widespread occurrence of podzols (ash-colored soils) under the northern coniferous forests, of chernozems (black earths) in the more southern wheat-growing zone, of chestnut soils in the drier grasslands. Dokuchaiev concluded that this distribution was the result of climate. Podzols, chernozems, and chestnut soils were subsequently recognized in North America also and were found to occur in broad zones with climatic conditions and vegetation somewhat similar to those in Russia. The name *great soil group* has been given to podzols, chernozems, chestnut soils, and the comparable taxonomic assemblages, of which 36 were listed in the 1938 yearbook of the United States Department of Agriculture and 37 by James Thorp and Guy D. Smith in the present symposium. Both lists are weak on tropical soils; neither list includes the extensive dark-colored soils of tropical savannas, which do, however, receive prominent mention by Charles E. Kellogg in his contribution to a more recent publication, "Efficient Use of Fertilizers" (FAO, Washington, D. C., 1949).

Thorp and Smith in a well-balanced discussion admit that this presentation of the major kinds of soil so far studied has been "influenced by geographic considerations and by a multitude of hypotheses of soil genesis, some well substantiated and others with obvious flaws." The system presented retains traces of an overemphasis on climate as a factor in soil formation. Soils clearly revealing the influence of climate were called "zonal"; adjacent soils were called "intrazonal" or "azonal." Thorp and Smith note major weaknesses in this point of view but are not yet able to abandon it.

The American system of soil classification thus carries over from an earlier period of soil science a broad classification into three *orders*: zonal, intrazonal, and azonal. There are also *suborders*, an unsatisfactory compromise, arrived at by assembling the great soil groups partly on the basis of similarity and partly on the basis of contiguity. The great soil groups themselves are not yet defined in a final manner, but, in the opinion of many pedologists, they form a reasonably close approximation to what is wanted. They are convenient, provisional labels.

There is a gap between the widely used and loosely defined great soil groups and the soil types that are clearly defined units of great practical importance. Students are taught that

the great soil group is composed of soil families, the soil family is composed of soil series, and the soil series is composed of soil types. Since the soil series often includes but a single soil type and no longer serves its original purpose, it could perhaps be allowed to disappear. As noted by Riecken and Smith, one problem in the making of soil families is that of nomenclature. At present local names give no clue to the nature of the soils. To devise more significant names will, however, be difficult.

The system of soil classification described in this symposium is not convincing as a whole, but it has a sound basis in the scrupulous accuracy displayed in the identification of the soil type, though Marbut's ten criteria have undergone some changes in interpretation; for instance, more weight is now given to laboratory tests. It may be remarked also that, although Marbut's criteria do not specifically include drainage conditions, these are in fact recognized and have been adroitly used in grouping soil types. A good example is to be found in the soil map of Johnson County, Indiana (H. P. Ulrich and associates), issued by the United States Department of Agriculture in May, 1948. It often happens that practice is ahead of theory, and it may be that this instance foreshadows a change in the taxonomic grouping of soils.—H. A. GREENE

SOUTH AMERICA

COTTON IN PERU. The story of cotton is one of the most interesting plant stories. We now know a great deal about the genetics of the cottons, wild and domesticated, of the entire world. In a useful and readable "Report on Cotton" (With Special Reference to Cotton as a Crop in Peru, Institute of Inter-American Affairs, Washington, D. C.; Food Supply Division, Lima, Peru, 1948) G. Edward Nicholson summarizes this information and illustrates the application of botanical knowledge to an economic problem in a particular area.

Cotton is known to have been the basis of a highly developed industry in India by 1500 B.C. and was used in America almost as early. Intensive cultivation, however, dates from the eighteenth century and the mechanical revolution. The mechanical revolution created a plant-breeding revolution also: new cottons had to be created to meet the new requirements.

The textile industry demands cotton fibers of different types. Nicholson describes the characteristics of each of the cottons, the methods of grading quality, and the factors influencing the yield of lint per acre. That usefulness determines value is an important point. Uniformity is essential for manufacturing. Hence there is emphasis on "one variety community" and on uniform treatment (picking, fertilizing, cultivation, etc.) in order to get a standard product. It is interesting to see the impact of the type of demand both on the cultural patterns and on the biology of the plant. Yet despite the pressure of industry the greatest extension of cultivation of the major species of cultivated cottons is still near their centers of origin: *Gossypium barbadense* in South and Central America; *G. hirsutum* in North and Central America; *G. herbaceum* and *G. arboreum* in Asia.

The origin of these basic cottons is a fascinating though controversial question. Nicholson tends to follow Hutchinson, Silow, and Stephens' theory of an African origin of domestic cotton for its oily seed; the development of cotton for its lint in India well before 1500 B.C.; the transport, probably by man, of one of the Indian domestic cottons to the New World to give rise by hybridization with New World wild cotton to a new group of domestic cottons (see the review of Hutchinson, Silow, and Stephens' "The Evolution of *Gossypium*," *Geogr. Rev.*, Vol. 38, 1948, pp. 167-169). The evidence for this is found in the genetics of cotton.

The probability of man's intervention has been greatly increased by the discovery in Peru of an archeological level containing cotton, in addition to bottle gourds and *Canavalia* beans, all believed to have an Asiatic, probably Indian, home (Junius Bird: *America's Oldest Farmers*, *Natural History*, Vol. 57, 1948, pp. 296-303 and 334-335). Further, C. R. Stonor and Edgar Anderson have just presented evidence indicating that maize also was carried across the Pacific many centuries before A.D. 1500 ("Maize among the Hill Peoples of Assam," *Annals Missouri Bot. Garden*, Vol. 36, 1949, pp. 355-404). Further evidence of similar early transpacific contacts was presented at the Congress of Americanists held in New York in September, 1949.

Cotton has an ancient history in Peru. It is now known to have been cultivated long before 1000 B.C., perhaps as early as 3000 B.C., and cotton weaving was a highly developed art in pre-Inca and Inca times. Cotton growing declined under the Spanish but revived during the American Civil War. Favorable natural and economic factors (climate and guano, a good indigenous variety, low value of land, cheap labor, wars) made the early haphazard culture successful. In 1920 definite interest in the cotton industry finally appeared. New varieties were introduced, scientific study of cultivation problems began. Concentration now is on cultivation methods, insect pests, and plant breeding.

Cotton is grown in Peru in the irrigated coastal zone. Here it finds "adequate water, freedom from storms, frosts, and other sudden weather changes, open very sunny weather and mean annual temperature of over 60° F." It is grown on a large scale in the far north (Piura), and it is the most important crop in the center (Lima and Ica), where it has displaced sugar cane. In the Piura area annual Pima cotton is now raised; in the central and southern areas Tangüis cotton dominates.

Acreage in cotton has decreased slightly since 1935, exports have decreased considerably, and internal consumption has risen rapidly. Peruvian export has suffered from the wartime and postwar trade disruptions. Attempts have been made, contradictorily, to grow more food to feed an increasingly urban population and simultaneously increase exports. Peruvian agriculture is in the throes of reorientation to a more balanced system in which food crops for the nation are of equal importance with crops for export.

Peruvian cotton is of high quality and is used in luxury goods. It now commands a very high price in the European market. But Peru has virtually priced itself out of the South American market, and such countries as Colombia and Brazil are experimenting with growing their own Tangüis cotton.

Thus Peru faces a series of interlocked problems. She has a fixed amount of irrigable coastal land. She needs more food and more export, but the two are contradictory; she can cash in now on high European prices but risks losing her long-term Latin-American market. The trend seems to be toward a more balanced farming, with hopes that improved cotton varieties and better agronomic practices may enable her in part to keep up her cotton exports.—GEORGE F. CARTER

TRADITION AND TRANSITION IN A RURAL BRAZILIAN CULTURE. Cunha is a predominantly rural *município* of about 25,000 inhabitants in the mountains of São Paulo State, Brazil, on the border of the State of Rio de Janeiro. The town of Cunha, the subject of a study by Dr. Emilio Willems (Cunha: *Tradição e transição em uma cultura rural do Brasil*, Secretaria da Agricultura, São Paulo, 1947), was founded in 1724 and during the

empire attained some importance as a stop on the paved highway from Minas Gerais to the port of Paratí. But when coffee growing went up the Paraíba Valley into São Paulo State, the Cunha region was passed by, and, later, the value of its highway was destroyed when the Estrada de Ferro Central do Brasil was built across the direction of the old flow of trade from Minas Gerais to the sea. Thus, left remote by the main economic and demographic currents of that part of Brazil, it remained in a historic backwater until the building of the highway from Guaratinguetá in 1932 once more brought it into contact with the world outside.

But it never was, nor did it ever become, a primitive society. Dr. Willems, who is a master of the technique of cultural as well as of physical anthropology, makes that point clear. What interests him most is the conflict in Cunha between the traditional ways perpetuated in the backwater and the influences from outside. He gives one-quarter of his book to an anthropometric analysis of the population, but the rest to a description of the land and the people, the social structure, the local culture, and ecological changes. The economic base is the growing of beans and corn, largely for subsistence, and around this agriculture revolves a whole system of customs and habits, such as the *mutirão*, when the whole neighborhood pitches in to help a family with some undertaking too large for individual action (for example, harvesting or house building). Dr. Willems' study, then, catches communal ceremonies, dances, beliefs, and religious observances in transition, but before they have lost their old vitality. If his text is lucid and thoughtful, it also derives much interest from the well-chosen illustrations, of which there are not quite enough.—ALEXANDER MARCHANT

EUROPE

DEPOPULATION IN THE SCOTTISH HIGHLANDS AND ISLANDS. "The persistent depopulation of the Highlands and many of the Islands of Scotland has been considered a major problem by the Scots for almost a century" (W. A. Hance: *The Outer Hebrides in Relation to Highland Depopulation* [Thesis, Ph.D., Columbia University], New York, 1949). Census returns since 1861 have shown a population decrease in all the seven "crofter counties" of Zetland, Orkney, Caithness, Sutherland, Ross and Cromarty, Inverness, and Argyll. These seven counties, occupying 47 per cent of the area of Scotland, have now (1947) only some 6 per cent of its population. In the Hebrides the decrease was rapid from 1911 on, and especially so during the decade, 1921-1931, when overseas migration reached its peak and losses of several thousands were common in every district.

The largest decreases have taken place in the purely rural areas, notably the peninsular parts of the western counties. The West Highland Survey (Occasional Communication, August, 1948) finds that in the northwest Assynt Parish (Sutherland County) and Sleat Parish on the island of Skye each decreased by more than 50 per cent from 1911 to 1947 (latest figure calculated by parishes). Statistics for the smaller villages and hamlets also indicate a loss of population, but not to so high a degree. The larger towns experienced the opposite trend; Fort William almost doubled its population, and Stornoway reached 139 per cent of its 1911 figure.

In a recent study of population changes in the crofter counties H. A. Rendel Govan, planning consultant for Ross and Cromarty County, compares age pyramids of the northern counties of Scotland for 1871 and 1931 (in "Scotland's Changing Population," edited by A. M. Struthers, published for the Scottish Council of Social Service by the National Coun-

cil of Social Service, London, n. d., pp. 41-48) and finds that the character of the population has undergone radical changes. The pyramid for 1871 indicates a well-balanced population, with sufficient numbers of young adults to maintain the birth rate. Sixty years later the picture is very different. Not only is there a decrease in numbers, but the structure of the pyramid has altered; the fifty and over age group has increased, and there is a corresponding decrease in the number of children under 10 years. The population of the northwest of Scotland has become an aging population as a result of extensive migrations during the past two decades.

What factors lie behind this exodus? To find an answer, it is necessary to review the region geographically, to examine its resources and inquire into its economy. "The outstanding characteristic of this great Region is the narrowness of the inhabited tracts amid a vast expanse of moorland, mountain and sea" (Arthur Geddes and F. D. N. Spaven: *The Highlands and Isles, in Studies in Regional Planning*, by G. H. J. Daysh and others, London [George Philip & Son], 1949, pp. 1-53). High serrated peaks dip steeply, in some places precipitously, to the ocean. The mountains are dissected by long, narrow glens, which, together with the stretches of raised beach, or *machair*, afford some level land for cultivation. The Western Islands are lower than the mainland, and their topography is less rugged, but the amount of level land is no greater. Although the same general climatic type covers the whole of Scotland, microclimatic studies show that the northwest receives a much heavier rainfall than the east coast, which lies in the lee of the Grampians. A second deterrent to cultivation is the strong wind that sweeps across the Western Islands and buffets the headlands of the mainland. As a result of the excessive precipitation and the low porosity of the crystalline rocks, the soils tend to be waterlogged, sour, and infertile; peat forms easily and covers much of the poorly drained lower slopes.

The "crofter counties" are so called because of the prevalence of the croft type of farm unit. The outstanding characteristic of the croft is its small size, which results partly from the small amount of cultivable land available and partly from the clan system, with its subdivision of holdings. The Scottish crofter wrests as much as he can from the land but is forced to supplement his income in other ways. If the croft lies near the coast or one of the sea lochs, fishing becomes a part-time occupation, often a valuable one. An inland crofter may keep a few cows and add dairying to his subsistence crofting. A third and now popular part-time industry is the hand-loom weaving of tweed. This has become such a lucrative business that frequently all else is sacrificed to it.

There are few areas where all three of these subsidiary industries are carried on simultaneously. The island of Lewis is the most notable exception, and here the maintenance of a well-balanced economy has been an important factor resisting the general trend of emigration, though the isolation of the island must also be taken into account. It is on Lewis that the culture, traditions, customs, and language of the Highlands have been best preserved. The burgh of Stornoway is the chief distributing center for the islands, and although many islanders have been drawn there by the opportunities, the rural areas are not in the same sorry condition as similar areas on the mainland.

On the mainland, the severest decreases in population have in general occurred in the areas where people live by subsistence crofting alone. The population of the poorer, less accessible peninsulas has been so seriously diminished that unless drastic measures are soon taken the north of Scotland may be emptied of inhabitants. Mr. Govan points out that "in

a small population there comes a time when any further depopulation makes it impossible for those remaining to carry on, and the place has to be evacuated." He continues: "A small emigration from the central belt of Scotland (and there are people ready to come if work and houses are available) would re-populate the Highlands." One stumbling block to the realization of this theory is the lower standard of living in the Highlands, which Lowland Scots are unwilling to accept. Unless living conditions are improved, an emigration from south to north can never be successful.

There are ways, however, in which the Highlands could expand their economy with a little help from outside. Dolomite and garnets occur in sufficient quantity to make mining profitable, if initially somewhat expensive. Experiments have been made to utilize peat in various industries, and although no satisfactory results have yet been obtained, there is still hope; at the moment peat is the main fuel on the islands and much of the mainland. The kelp industry could be considerably enlarged. Afforestation is already under way in many regions, and the Forestry Commission plans an extensive campaign that will provide employment for crofters in less accessible areas. Finally, the tourist industry could prove lucrative if the proper facilities were available; the Highland scenery is majestic and beautiful, but accommodations for the most part are poor.

A concerted effort along some of these lines might stem, if not end, the flow of people from the Highlands.

AFRICA

ELGIN, A DECIDUOUS-FRUIT-GROWING AREA OF SOUTH AFRICA. Prominent among the deciduous-fruit-growing areas of South Africa is Elgin, some 40 miles east of Capetown. In the last prewar season nearly half the apples and peaches exported from the Union were grown in Elgin's 140 square miles. The reasons for this specialization are discussed by M. M. Cole in "Elgin, Caledon District, Cape Province: A Land Utilization Survey" (*South African Geogr. Journ.*, Vol. 31, 1949, pp. 36-76). The Elgin synclinal basin is a maze of low hills and narrow kloofs (500 to 1000 feet), well drained by streams from the surrounding heights (1500 to 3000 feet). A line of springs at the contact of the Table Mountain Sandstone and the shales and sands of the basin (Bokkeveld formation) also contribute to the supply of irrigation water needed in the dry summer season. Most of the 40 inches of mean annual rain falls during May to August inclusive. When rainfall is deficient, the fruit crop is reduced; for example, in the 1934-1935 season, when the rainfall was 10 inches below normal, the crop was one of the poorest on record. Relatively cool winters (mean minima 34° to 40° F.) permit the dormancy stage required by deciduous fruit trees. This in part explains the relative importance of the apple in Elgin. The varied configuration of the land and the correspondingly varied temperatures account for the variety of fruits: peaches do best with a summer maximum above 75°; pears, 75° to 80°; apricots, 69° to 73°; plums, 62° to 68°; apples, 65° to 70°. Apples, peaches, and pears grow on the south-facing slopes; apricots and vineyards are on the north-facing slopes. Peaches occupy the shallower and more gravelly soils of the hilltops, apples the heavier loams of the mid-slopes, pears the clays of the kloofs. The great diurnal temperature ranges create certain problems. In late winter and early spring, inversion effects in the lower parts of the basin give rise to low early-morning temperatures; the rapid warming strains the bark of the trees and opens it to the entry of disease organisms. Heatspot and sunscald are associated with exceptionally high

summer maxima, created by descending air currents; early-ripening plums are particularly susceptible.

Various other forms of land utilization in the basin are related to the fruit industry. The need for animal manure for the orchards has stimulated improvement of pasture on the steep slopes bounding the basin. Plantations of coniferous trees have been introduced to meet demands for softwood timber, but here a certain conflict in use threatens, for streams in catchment areas with extensive planting show a diminished flow.

ASIA

A NEW CAPITAL CITY FOR EAST PUNJAB. Plans for the building of an entirely new city to serve as the capital of East Punjab have recently been initiated (see the *New York Herald Tribune*, Jan. 25, 1950), and it is hoped that construction may be begun within a period of six months. The site chosen lies 140 miles north of New Delhi on land that is not suitable for cultivation and therefore is readily available without opposition; the problem of acute land hunger in India is one that must be considered in any kind of planning.

The planner faces other problems as well. Traffic, for example, must be provided for on the same principles as elsewhere; that is, an attempt should be made to minimize the volume of traffic by the most convenient interrelation of living, working, and recreational areas, to produce safety and convenience for pedestrians and vehicles, and to foresee changes as far ahead as possible and to allow for those that cannot be foreseen. But in India special circumstances must also be considered; there are some automobiles, trucks, busses, and motorcycles, but a larger number of horse-drawn and bullock-drawn vehicles, cycles, man-pushed carts, and pedestrians. Not only does this situation offer a more complex combination of methods and speeds than in the west, but greater difficulty in allowing for the undoubted proportionate increase in motor vehicles. It is our hope to keep the spirit of the bazaar in the shopping centers, not to formalize it and make it dignified or aseptic but to sublimate its virtues and combine them with ours—for example in the elimination of wheeled vehicles and the provision of sanitary controls. As we cannot know in what form or to what degree services to citizens will increase as India develops her resources and adds to her wealth so as to give her people the kind of life and opportunity her leaders desire, we must allow in the new city adequate open spaces and interstitial spaces for unknown future buildings and functions. In another respect, however, space requirements will be lessened. In India it has been the practice, even in large cities, for the bungalows of the well-to-do to occupy huge sites within the city, often covering several acres. In terms of cost of streets, and water, sewer, and electric lines, a modern city can afford this only at the expense of depriving the poorer areas of these facilities and drastically curtailing their space allotments. In the new capital private sites will be restricted to one acre.

In one aspect we hope to break new ground—the application of microclimatology to city design. This is especially important in northern India with its extreme summer heat and its two cold winter months (unpleasantly cold night and morning, yet not cold enough to require heating systems). Everything possible will be done to arrange orientation of buildings, appropriate planting, and so on to minimize the unpleasantness of the climatic conditions without resorting, except in a few instances, to the costly benefits of artificial-ventilating, air-conditioning, and heating systems.

The first phase of construction, which is scheduled for completion within five years,

aims to accommodate some 150,000 persons, but long-range plans call for expansion to a city of 500,000.—ALBERT MAYER. [Mr. Mayer is the New York architect and planning consultant charged with the design of the new city.—EDIT. NOTE.]

AUSTRALASIA AND OCEANIA

THE AUSTRALIAN COAL INDUSTRY. The general strike by 24,000 Australian miners from June 24 to August 17, 1949, provided the latest illustration of the long-time instability of labor-employer relations in the coal industry. The miners demanded a 35-hour week (instead of a 40-hour week), increased pay, longer holiday leave, and nationalization of the industry. The Labour government charged that the walkout was Communist-inspired and that it ignored the Commonwealth's machinery for compulsory arbitration of labor disputes. The nation was caught with an inadequate stock of coal, and many communities were obliged to accept restrictions on the use of fuel and electric power. Transportation and industry suffered severely, and the army was assigned to produce coal from open pits on August 1. After the seven-week walkout, the miners returned to work, on the understanding that their demands for a shorter week and higher pay would go to arbitration.

It is evident to most observers that the New South Wales coal fields, which have long been the principal source of fuel and power in Australia, may be due for some difficult readjustments on the part of both labor and management. In "The Australian Coal Industry" (Melbourne University Press, Carlton, 1947) A. G. L. Shaw and G. R. Bruns analyze the problems of the industry in detail. Emphasis is on the period 1929-1939, but the situation in earlier and later years is briefly discussed. Markets, production, wages, worker welfare, and industrial strife are thoroughly dealt with. The authors point out that many conditions in the industry have been "intolerable" in the past. The traditional ill will between workers and operators continues to be one of the greatest problems. Also, the industry may in the near future be unable to market all the coal it is capable of producing under full and continuous operation. The conclusion reached is that future nationalization of the industry is almost inevitable; for it seems to offer both the greatest security for the worker and a regular supply of coal at a moderate price for the consumer. Private cartels, state boards of control, and other regulatory devices seem to be undesirable or halfway measures. The authors do not assert, however, that all the industry's problems would be solved by the simple expedient of nationalization.

Although Australian black-coal output in 1948 reached the 1942 high of 15 million tons, there is considerable evidence to suggest that reduced demand may follow the post-war boom. Rapid expansion of lignite production in Victoria, increased output of hydro-electric power in Tasmania and Victoria, increased efficiency in the consumption of coal, expansion of black-coal output in Queensland, and the shift to petroleum for railroad fuel are the principal threats to the continuance of the large demand for New South Wales coal. Other states are renewing their efforts to become independent of the unreliable supplies of coal (due to work stoppages) from New South Wales. Export of coal to foreign countries has for many years been declining in importance. The question is whether private owners or the state will be best able to meet these problems of adjusting production to demand; there are numerous examples in Australia of effective mine operation under both. A substantial growth in population and manufacturing industry in the future might help to absorb the full potential output of the coal industry.

Employee cooperation and responsibility will be necessary under either scheme of control or ownership. Many miners, even during the recent war years, displayed little willingness to work for the general welfare of the industry and the nation. Some operators have been notably autocratic. Australians are not interested in the nationalization of all industries, but they might consider it for coal. An industry based on the utilization of a natural resource would seem to them more eligible for public ownership or control than any of the usual factory industries. Then, too, public ownership and participation in industry have long been part of the Commonwealth scene. The results of recent nationalization of industry in Great Britain will be closely observed by Australians.—CLIFFORD M. ZIERER

PHYSICAL GEOGRAPHY

MAP PROJECTS ON THE SCALE OF 1:1,000,000. An outline of five projects dealing with problems related to vegetation and their cartographic interpretation on the scale of 1:1,000,000 was prepared by Henri Gaussen for the International Geographical Congress at Lisbon (April, 1949) (*Projets pour diverses cartes du monde à 1/1,000,000^e: La carte écologique du tapis végétal*, Lisbon, 1949 [extract from *Annales Agronomiques*, Vol. 19, 1949]). Developing a system he has used on the "Carte de la végétation de la France," 1:200,000 (published by the Centre National de la Recherche Scientifique), he presents a precise and well worked-out scheme for synthesizing various combinations of factors in each project and representing them by syntheses of colors, lines, dots, symbols, and so on.

Geological map of facies. Emphasis so far has been mainly on strata. Maps on which the colors were determined by the facies would present a more readable picture of the geologic landscape for a wider public, which generally wants to know the types and properties of rock formations rather than their age; for the benefit of geologists the strata could be indicated by letters or symbols.

Climatic maps. In view of the deficiency of data required for a synthesis of the various climatic elements, it is proposed to undertake first a map of the average annual precipitation, represented by colors, with summary indication of seasonal distribution and snowfall, by means of dots of varying colors and spacings. Overlays indicating probable harvests of specific crops would be of interest to agriculturists.

Ecological map of vegetation cover. The purpose is not only to map the present vegetation, both natural and as modified by man, but also to show the stable combination of environmental factors that determines the present and potential vegetation. The superposition of colors, each representing an environmental factor, will produce in any given spot a synthetic color that will indicate the stable milieu of that spot; the manner of putting on the color (lines, dots, symbols, and the like) will indicate the present natural or man-made vegetation.

The essential factors (temperature, humidity of air and soil, length of dry season, light, vegetation seasons, and nature of soil) would be represented in white for averages, with extreme values in bright colors; secondary factors (such as wind, period of snow cover, and freezing) would be represented in white for averages, with maxima in dark colors. Compensating factors, such as humidity of the air in an area of low precipitation, would be indicated. The reaction of a plant to a factor would be shown, not the factor in itself.

Six thermic types are differentiated (with possible intermediary types): very cold, cold,

temperate cold, temperate warm, warm, and hot. Six humidity types are differentiated: very dry, dry, fairly dry, slightly humid, humid, very humid. Representation of xerothermic factors would emphasize whether the dry season coincides with high or low temperatures, and the number of dry days during the consecutive dry months. If humidity is increased by fogs or dew during half of a dry day, it should be recorded as half of a dry day. Four types of dry period are differentiated: fewer than 50 dry days, from 50 to 100, from 100 to 150, more than 150. Light is classified as little, medium, and bright. Vegetation seasons are in four categories: short, less than six months; medium, from six to nine months; sub-equatorial; and continuous. Anthropogenetic vegetation would be indicated where important. Thirteen types of soils are differentiated.

The superposition of different combinations of colors representing the above factors may produce identical or similar resulting colors. These similarities will indicate similarity of milieu and interchangeable vegetation and may be useful in determining potential land use.

Twelve fundamental types of milieu are classified, with ecological formula, vegetation landscape, and color representation: very cold with medium light; very cold with strong light; cold without trees; cold with scattered trees; cold with forest; cold temperate; medium temperate; warm temperate; hot temperate; two types of hot; and very hot.

Pedological map. Instead of the various types of soils, the synthesis of the factors that have formed them would be indicated: nature of the parent rock, climate, vegetation, age. The choice of colors and manner of using them would permit easy analysis of the factors determining the soil and its degree of evolution.

Agricultural map. The number of plantings per year would be indicated; the rotation of crops, with frequency of recurrence and economic importance; and, where desirable, the value of crops rather than the acreage.

M. Gaussen expresses the hope that geographers, who are interested primarily in syntheses, will try out his suggested methods.

HUMAN GEOGRAPHY

"WORLD CROPS." *World Crops*, a new monthly periodical, with subtitle "Their Cultivation, Protection, Storage, Handling and Processing for Food, Fodder, and Industrial Products," is introduced by Sir E. John Russell (Sept., 1949). It makes a timely appearance, "when a great revolution is taking place in world agriculture," when food producers, hitherto "almost a race apart," are joining with scientists, engineers, and industrialists. The new journal is designed to present developments in modern agriculture "to all technicians likely to be interested: agricultural, engineering, chemical and others." To judge by the first six numbers received at the American Geographical Society, "others" should certainly include geographers. The articles, mostly original, are by authorities in their fields. Sir Harold Tempany writes on the future of cocoa (Sept., 1949) and on land use in the wet tropics (Dec., 1949). R. O. Whyte has an excellent paper on pastures and forage crops in the tropics (Oct., 1949), in which he stresses differences between familiar temperate and unfamiliar tropical conditions. Our ignorance of tropical circumstance is also underlined by G. B. Masfield (author of "A Handbook of Tropical Agriculture," 1949), who argues the need for a revolution in tropical peasant farming, by which he means both a revolution in the peasant's conception of farming and a vastly increased know-how on the part of his

advisers. Masfield instances the scantiness of meteorological records; "the development of new areas, such as the East African groundnuts scheme, usually brings to light local variations in rainfall which are of profound importance to the practical farmer" (Dec., 1949, p. 147). There is a report on another of the British Overseas Food Corporation's projects, this one in Queensland—the mechanized production of sorghum for feeding to livestock, especially pigs (Sept., 1949). Other topics discussed are recent advances in tea research (Oct., Nov., Dec., 1949), the sisal industry in British East Africa (Nov., 1949) and coffee in East Africa (Dec., 1949), tobacco in the Commonwealth (Sept., 1949) and natural rubber in the Western Hemisphere (Feb., 1950). "New Techniques of Increasing Food Supplies" is a hopeful view of possibilities "on the technical plane" for raising production and living standards (Dec., 1949). A series of admirably concise articles on the world's cereals begins with rice, "staple food of half the world."

Some material is presented in the form of extracts or summaries; for example, Sir James Turner's address to the Royal Society of Arts on Britain's "Battle for Food," in which he invites the country to face realities, more urgent with the prospective termination of ERP aid in 1952 (Jan., 1950). Proceedings at important conferences are summarized, among them the Conservation Conference at Lake Success in August-September of last year, the Second International Congress of Crop Protection, London, July, 1949, and the Cocoa Industry Conference at London, in which the main concern was the problem of swollen shoot disease (Nov., 1949). There are interesting topical notes and an editorial comment.

The material in *World Crops* is largely drawn from British Commonwealth and colonial sources, and it is very well illustrated. The cover photographs of the first two numbers, however, are from the United States, and two members of the Netherlands Government Service for Agricultural Rehabilitation report on the reclamation of Walcheren (Sept., 1949).

World Crops is published by Leonard Hill Limited, 17 Stratford Place, London W. 1, England.

OBITUARIES

OLIVER EDWIN BAKER. Oliver Edwin Baker, formerly chairman of the Department of Geography of the University of Maryland, died at his home in College Park on December 2, 1949, aged 66 years. When Dr. Baker joined the faculty at Maryland in 1942, no courses in geography were offered; today the university has what is considered to be one of the outstanding departments of geography in the country, with graduate students from all parts of the world. This development in seven short years is a tribute to Dr. Baker's vision and efforts. In June, 1949, he retired from his position as chairman in order to devote more time to research, particularly in connection with the North American section of the Atlas of World Resources being compiled for the Department of Agriculture and the Bureau of Mines.

After two years with the Wisconsin Agricultural Experiment Station, Dr. Baker began in 1912 his 30-year association with the United States Department of Agriculture. The editing of the Atlas of American Agriculture and the Economic Atlas of the World, studies of farm population and rural-youth surveys, and the development of graphic summaries to illustrate important trends in agriculture were his major contributions of this period.

Long a recognized authority on agricultural land utilization, Dr. Baker had a thorough knowledge of all parts of the country and frequently amazed his students by quoting statistics

for almost any of the 3000 counties in the United States. Two of his many papers that may be selected for mention are a contribution to the *Geographical Review* in 1928, "Population, Food Supply, and American Agriculture," and his presidential address to the Association of American Geographers in 1932, "Agricultural Migration and the National Welfare," a masterly analysis of the problems of American agriculture—outgrowths of work with the Bureau of the Census that revealed the decline of population in the Western World. This trend, together with the general urban movement of farm people and their subsequent changed values, he found of significance. Dr. Baker was a strong advocate of what he called "rurban" living—a combination of city employment and suburban living, with some degree of self-sufficiency provided by part-time farming. Such a way of life, he felt, might create a better balance between the rapid pace of the city and the comparative monotony of the farm. Family ties would be strengthened, a higher birth rate result. The philosophical and religious implications of the falling birth rate and the decline of family life were frequent topics of addresses.

All of those who came in contact with Dr. Baker not only profited from his vast knowledge but also learned the full significance of one of his favorite quotations, "There is no wealth but life."

ELICIO COLIN. Elicio Colin, editor for the past 30 years of the *Bibliographie Géographique Internationale*, passed away on November 15, 1949, in Quéménéven, near Brest, at the age of 75. As a student at the University of Paris in the 1890's, he belonged to the famous group of pupils of Vidal de la Blache. For nearly 40 years he taught at the Lycée Saint-Louis in Paris, from which he retired in 1937. He is the author of some port and regional studies and the editor of a series of secondary-school textbooks. But his major contribution to geography—which deserves the gratitude of all geographers and of scholars in many other disciplines as well—is his editorship of the *Bibliographie*. In 1891 the new *Annales de Géographie* began the publication of an annual bibliography under the editorship of Louis Raveneau. In 1919 Colin took over, and under his guidance this useful tool was considerably enlarged and improved. In 1923 the American Geographical Society collaborated with the Association de Géographes Français in the preparation of the volume, and shortly thereafter Italian, British, and other geographers joined in. The *Bibliographie Géographique Internationale* became a standard and indispensable work, of world-wide fame and use. To it, Elicio Colin gave the best of his time and effort. During the difficult war years he carried on in a small Breton village. With his son-in-law, the mayor, M. Colin was arrested by the German occupation authorities for assisting in the escape of some American fliers. He spent several weeks in jail, and his son-in-law went to a concentration camp for two years. After liberation, Colin again started the *Bibliographie*, against heavy odds, putting Quéménéven on the map for all geographical societies. On the morning of his death, he was still reading the proofs of the 1947 volume. To honor his memory one could not do better than express the wish that his *Bibliographie* be carried on in the pattern he so successfully set.—JEAN GOTTMANN

GEOGRAPHICAL REVIEWS

L'AMÉRIQUE. By JEAN GOTTMANN. 451 pp.; maps, diags., ill., bibliogr. (Les Cinq Parties du Monde.) Librairie Hachette, Paris, 1949. 9 x 5½ inches.

This book is the first of five volumes on "the five parts of the world" to be published by the well-known Librairie Hachette. In a short foreword the publishers explain the purpose of the series: to present in an attractive, concrete, and popular form a geographic picture of the postwar world. And they add: "In an era that poses social and economic problems on a world-wide scale geography—combining description, explanation, and comparison—serves as a guide in the accelerated movement of history." One wishes that American publishers would or could with equal confidence offer a geography series to the general public!

Among the younger French geographers Jean Gottmann is certainly the most capable and best equipped to undertake the formidable task of presenting a *tableau* of the Americas. He knows North America well from long sojourns and has made several visits to Middle and South America. He has observed carefully and read widely; above all, he knows how to present, admirably, the fruits of his scholarship to a nonprofessional audience. The plan of the book is simple. The first part (some 80 pages) sketches the physical framework, the history of settlement, and the modes of occupancy ("l'organisation de l'espace"). The second part (some 160 pages) deals with Anglo-Saxon America, including the Arctic outposts, the third (75 pages) with Middle America, and the fourth (100 pages) with South America. The allotment of page space seems fair enough, but at the same time the figures suggest, to the American at least, the difficult task of condensation the author undertook.

In achieving the purpose of the book Gottmann has, on the whole, succeeded very well indeed. The text moves back and forth with ease between factual description and searching interpretation, aided by some 80 maps, cartograms, and graphs and numerous photographs. The French reader who digests this objective and fair-minded survey will certainly have gained a better understanding of the Western Hemisphere. For the American geographer the volume has a twofold value. It is always interesting to learn how a "foreigner" (much too sharp a term in this case) looks at America, and, second, to see how an esteemed colleague performs a difficult task. If these views lead to critical remarks—aside from a sincere respect for a job well done—the author can ignore them as beside the point. He can rightly maintain that he did not write for American readers, much less for professional geographers.

The farther I read, the more I began to doubt the wisdom of any attempt to cover the whole Western Hemisphere in one study. Gottmann is quite aware of the problem. He speaks of the divergent "spiritual sources of the two Americas" (p. 73)—that is, Anglo-Saxon America and Latin America—and of their "different philosophies of life" (p. 426). In a section called "La dualité du Nouveau Monde" (pp. 82–84) he specifically poses the question of disparity or fundamental unity. One might argue the case simply in terms of scale of presentation: the larger the area, the greater the diversities we have to face in our attempts to grasp its essential traits. This argument, however true in itself, is not satisfying. The delimitation of a geographic region, large or small, must rest on some criterion. Gottmann's interest, in line with the French tradition, is in the *genre de vie*, that appealing but vague concept which he seems to use interchangeably with "civilization." The "American" *genre de vie* and its impress on the land are a creation of the mind, of a forceful imagination,

of a wonderful dream (pp. 5-6). The basic criterion, then, is cultural, or even social-psychological. With this framework, would it not have been more logical to limit the book to one of the two major, disparate, civilizations instead of embracing both because they happen to occur on a continuous land mass? The author makes valiant efforts to show the fundamental unity of "l'Amérique." There is, of course, no denying that in comparison with Europe the New World as a whole has certain marked characteristics, but these (as mentioned on p. 84) result largely from its newness and are possessed equally by, say, Australia.

This is not to suggest that comparisons between Anglo-Saxon America and Latin America do not have value. On the contrary, they give depth to the analysis. One of the best chapters is that on "The Organization of Space," in which the differences in attitude toward the land are well brought out. The massive state organization in the North, with political control reaching from ocean to ocean, is contrasted with the political fragmentation of Middle and South America. In an almost passing sentence (p. 82) Gottmann refers to the possibility that the differences in natural environment have contributed to this contrast. The question might well have been explored further, with particular reference to English and Dutch colonies in the Antilles and Guiana.

The organization of the habitat is, according to Gottmann, still the essential domestic problem. Internationally, he sees a great dilemma for the United States in its present world leadership. Will it champion Anglo-Saxon superiority or become the shining exemplar of ethnic tolerance and cooperation? The author leaves little doubt that he views with alarm the ethnic discrimination practiced in this country.

Gottmann's more intimate knowledge of North America shows itself in a more thorough treatment. Whereas the parts on Middle and South America consist of regional descriptions, the part on Anglo-Saxon America opens with a general chapter on "Natural and Human Regions" and closes with an evaluation of "The Civilization of the United States." The author is struck, like every other visitor, by the uniformity of life throughout this country, but he believes that regionalism is evolving as local groups become identified more closely with their habitats. It seems to me that this observation is correct, but I am doubtful whether genuine regionalism will conform to watershed planning areas, as Gottmann seems to suggest.

His obvious predilection for human geography is an advantage for a book of this kind. Nevertheless, some geographers will feel that physical geography has been cut to the bone, if not further. On the other hand—and here I would side with the critics—he has shifted the center of attention far to the social side. In terms of French personalities, he does not sit at the feet of Vidal de la Blache, but next to André Siegfried. This is well illustrated in the chapter on the civilization of the United States. In method and outlook it is a pocket edition of Siegfried's classic, "*Les États-Unis d'aujourd'hui*" (published in English under the title "*America Comes of Age*," New York, 1927), though not without merits of its own. Here, in a quick review of 24 pages, are appraisals, or at least impressions, of material power and the power of materialism, waste and conservation, advertising and salesmanship, management and labor, cultural nivellation and racial discrimination, boundless energy and nervous fatigue, plus several other aspects of American life. Who would dare to say that these things have no bearing on the *genre de vie*? It all depends on the presentation, on the integration with other geographic phenomena; and it was here that I felt somewhat uneasy about this neo-Siegfriedian venture amidst the geographic tableau of the Americas. Gott-

mann's remarks on the standardization of American life are both true and trite. The French have heard so much about this that it would have been refreshing if a geographer had for a change pointed out the differentiation which is undeniably present under the gloss.

The chapters devoted to regional description had to be brief, too brief in fact, but the author has made the best of his condensation. There is, to my taste, an overemphasis on the description of cities. For instance, one page each is devoted to Buenos Aires and to the Pampa, and the cities and traffic of the Great Lakes receive three or four times as much space as the agriculture around the lakes. However, this urban focus may well be the better way to hold the attention of the layman, who becomes easily lost in the details of agrarian types of economy.

By now it may seem that there is much to criticize after the initial praise. Yet it should be remembered that few of these observations detract from the value of the book as an honest and lucid portrayal of "l'Amérique" for the French public.—JAN O. M. BROEK

DAS KLIMA GRIECHENLANDS. By ALFRED PHILIPPSON. 238 pp.; maps, bibliogr. Ferd. Dümmlers Verlag, Bonn, 1948. 8¼ x 5¾ inches.

It was more than 60 years ago that Professor Philippson's first writing on the climatology of Greece appeared in the *Meteorologische Zeitschrift*. Since that time students of the Mediterranean have come to know, to enjoy, and to respect the great contribution he has made to our knowledge of that region. His most recent book again deals with the climate of Greece. It is a highly authoritative and enjoyable summation of studies on the subject, which reveals the author's wide acquaintance with local and foreign observations and draws heavily on the knowledge and experience accumulated during his many field seasons in Greece and the eastern Mediterranean.

Professor Philippson's ability to conjure up an image equals his scientific accuracy in presenting facts (see, for example, the discussion of color in the atmosphere of Greece, pp. 76-78). In his account of the winds he gives us a composite picture of classical and modern, popular and scientific, knowledge of winds and places the wind system of Greece in its eastern Mediterranean frame. In the description of the seasons the reader is made aware not only of the facts of climate but of their manifestations: the parched days of summer, the rainy and cool and windy days of winter; the devastating effect of the sun in July and August, the relief to man and beast brought by the onshore winds.

But the book is not merely an analysis of meteorological phenomena. The presentation of the elements of Greek climate is followed by a description of the climatic provinces of the country, which enlarges our knowledge of Mediterranean climates and points the way to further climatological studies of other parts of the Mediterranean basin. Finally, the author discusses, in considerable detail and with the originality and excellence of style characteristic of his work, the effect of climate on man. This concluding discussion merits a place on the classic pages of Mediterranean geography. It is a survey of climatic influences on such diverse aspects of human life as disease, nutrition, housing, transportation, and agriculture.

This volume is both a fruition and a promise—a fruition of many decades of observation, travel, and research, and a promise that the great German geographical tradition, so nobly preserved and carried on by men of the stature of Professor Philippson, will continue to enrich geographical literature.—GEORGE KISH

THE ORIGIN AND DEVELOPMENT OF THE PORTS OF THE UNITED KINGDOM. By SIR DAVID J. OWEN. 2nd edit. 378 pp.; map, ills., index. Allman & Son Ltd., London, 1948. 30s. 9 x 6 inches.

This book was first published in 1939. In the revised edition the author has included a number of important changes occurring in the intervening years, not least among them the facts of changed control consequent on the Transport Act of 1947. The ports of Britain have been affected by this postwar legislation in several ways, though it is too soon to see what the eventual outcome will be.

It is rather strange that, though there have been studies of individual ports, some of real value and significance, there is a lack of more comprehensive material on British ports in general, and, for that matter, on British shipping. The shortage of material on ports is not, of course, peculiar to Britain, and the Commission on Ports of the International Geographical Union may be taken as an appreciation of the need to encourage those more systematic studies which play a vital part in the conduct of international trade. In this particular publication there is put together a series of brief but clear accounts of the ports of the United Kingdom, the whole preceded by a concise essay on the origin and nature of ports and concluded by a chapter on the coordination of ports and transport. In each study, whether of a single port such as Southampton or of a group of ports such as those of South Wales, the author is concerned with the need to indicate the facts of origin and growth, of facilities and nature of trade, and of the system of organization or control that existed before the most recent legislation. The word "indicate" is used deliberately. If the author had attempted to deal with the complete range of historical data, his book might well have passed out of his control. The report (1924) of the Port Facilities Committee appointed by the Chamber of Shipping of the United Kingdom, which had to do with facilities alone, ran to some three hundred pages. In the present work summarization has been necessary, and this applies not only to the facts of development but also to the analysis of the character and function of the ports.

It follows, then, that although this book is a useful reference, much that is significant is missing. Over the many years of industrial growth in Britain the fortunes of her ports have waxed and waned. The natural ability of a port to meet changes in the size and draft of vessels, the degree of regional industrial specialization, the nature of the internal transport systems, and many other facts have influenced port development. In such a work as Sir David Owen's there is no space for a full examination of the changes in status of the ports or for an analysis of the trends in their economic activity and function. The reader must seek elsewhere, too, for the essential facts about the hinterland and its relation to the present or recent situation of the port.

The book contains many photographs, some of them aerial, but no plans of the ports. The photographs are in general well selected and of assistance to an understanding of the nature of the ports, but their value would be greater if they could be related to a simple plan, or if there could at least be some indication of whether the reader is looking east, west, north, or south. For the aerial views a directional guide is necessary and could have been easily given. These comments are not intended as adverse or destructive criticism. They are meant to help define the scope and content of a factual and authoritative publication. Within its limited field, the book is essentially a reference work, and one that may stimulate further inquiry.—G. H. J. DAYSH

URBAN GEOGRAPHY: A Study of Site, Evolution, Pattern and Classification in Villages, Towns and Cities. By GRIFFITH TAYLOR. xv and 439 pp.; maps, diagrs., ills., bibliogr., index. [Methuen's Advanced Geographies.] Methuen & Co. Ltd., London, 1949. 25s. $8\frac{3}{4} \times 5\frac{1}{2}$ inches.

This volume is the fourth of a series covering, the author says, "the field of Cultural Geography." He hopes that as a "pioneer" work it will be of value to students of geography, sociology, and town planning.

The book contains numerous studies of towns in all parts of the world, based largely on the extensive travels of a lifetime, during which the author has always been an exemplary observer and recorder in note and sketch. It is unfortunate, however, that the field method he practices with excellent results is given such a pretentious title as the "circumspice concept," and that he fabricates baffling formulas as a shorthand for his observations and, incidentally, as a key to his working concept of the scope of urban geography. In spite of the skill with which many of the studies are handled, the book falls short of its overall purpose because of his insistence on a conceptual frame that cannot contain the detailed structure of his work.

It is doubtful whether the urban community can be adequately interpreted in terms of the concepts of other fields, either in scientific analysis or in generalized presentation. The "zones and strata concept," which Professor Taylor has used for many years, is inadequate in both. Concentric expansion is certainly one of the processes of urban growth, but, as Professor Taylor clearly demonstrates in sections, the study of areal differentiations within the urban complex, not the elaboration of one of the aspects of the process of growth, is the objective of urban geography. The student will be perturbed by the use of such terms as "hythergraph," "isopract," "isoterp," "Caledonian folding," "croded dome," and "Oldermass" and "Youngermass" (applicable to the highlands and lowlands of Britain), and by discussions of race traits and classification (on the first pages of the book) and prehistory.

The village is treated as the small cluster that emerges through the combination of several "urban" functions at one place. The author would indeed have been carried much too far had he included the study of rural settlements, as his subtitle suggests. Nevertheless, he finds occasion to introduce studies of rural settlements in the Adige corridor and elsewhere, with intriguing block diagrams of village sites and a diagram of changes of crops with altitude, all of which, however, have little relevance to the main theme. There is some vagueness in the author's definition of a town, for he considers that "a figure between 10,000 and 40,000 is the size of the cluster with which the term urban geography is usually associated," a statement that does not square with the facts. For this reason it is a pity that the functional classification of cities, to which reference is briefly made in the first pages, is relegated to the concluding chapter. Professor Taylor sees the development of the urban complex as a process of areal functional differentiation and interprets this in terms of the development of the cycle of erosion and the seven ages of man. Thus the "city cycle" involves stages termed "sub-infantile," "infantile," "juvenile," "adolescent," "early mature," "mature," "late mature," and "senile." The mode of functional differentiation is clearly conceived, but the labels are suspect.

The book is divided into three parts, dealing with general features (types of settlement in different latitudes and in the Mackenzie basin, and the city of Toronto), history of urban evolution, and "topographic and other controls." The controls of Part III con-

sidered in "the broadest sense" thus bring together towns as different as Vienna, New Orleans, and Bern simply because they lie on rivers. In a chapter on the regional distribution of towns it is suggested that there is a tendency in the United States "for the closely clustered cities to keep to an environment expressed by a temperature around 50° F., and a rainfall between thirty-three and forty-three inches a year," and that changes in the total rainfall are reflected in the spacing of towns, though "other factors must not be ignored altogether."

The arrangement and content of the book reveal a dilemma of which, perhaps, the author was not aware. It is an old story. The determinist (for Professor Taylor insists on being one of them) is in difficulties, since his interpretation of the "site, evolution, pattern and classification in villages, towns and cities," the material of urban geography according to Professor Taylor's definition, carries him far beyond the evaluation of the "controls" of the physical environment. In the detailed handling of his material, Professor Taylor is a possibilist, except for an occasional serious lapse, such as the one quoted in the previous paragraph.

The fact that the book is largely based on personal studies, with a strong individual interpretation, may explain the lack of reference to the numerous outstanding works by geographers in languages other than English. A small book by Lavedan is mentioned, but there is no word of his two-volume "*Histoire d'urbanisme*," the substance of Part II. There is no reference to the extensive and important German work. Professor Raoul Blanchard is relegated to a parenthesis, with no mention of his recent substantial studies on Montreal and Quebec, to say nothing of his classic work on Grenoble, first published in 1911. Names appear in the text without reference to sources, and these are not systematically listed in the bibliography.

Professor Taylor deplores the lack of teaching in urban geography. There is a plethora of urban geographical studies, and the choice of just another town is the line of least resistance for many a young graduate student. We need a clear exposition to the social sciences of what urban geography is, and the student of geography requires a clear portrayal of the field, and suggestions of meaningful lines of research, especially in the field of comparative urban geography. Professor Taylor's book fails to hit this mark, because it falls between the two stools of what he himself still describes as "determinism" and "possibilism." These are issues, we thought, that had finally been settled, and they would better have been omitted from the opening chapters, since the principles he endeavors here to enunciate do not in fact clarify the presentation and content of the book. This is probably the root reason why it should be read with caution and patience. For in spite of these criticisms it certainly is well worth reading, if only as a taste of Tayloriana.—R. E. DICKINSON

THE CLIMATOGRAPHIC ATLAS OF JAPAN: The Second Series, Climatology of Snow and Ice. Various paging; maps, diagrs. Central Meteorological Observatory, Tokyo, 1949. 10½ x 14¾ inches.

In March of 1948 the Central Meteorological Observatory of Japan released the first part of a new "Climatographic Atlas of Japan," containing data on temperature and precipitation. Now, as a joint effort of the meteorologists of the individual weather stations and the personnel of the C.M.O. Statistics Section, a second and more unusual part has appeared, "Climatology of Snow and Ice." The title would seem to suggest an approximately

equal emphasis on the two phenomena, and in this respect it is decidedly a misnomer. No fewer than 24 of the 30 maps and all the 31 pages of graphs and the 19 pages of tables deal specifically with snow, whereas only three maps relate to the freezing of water. Nevertheless, this effectively conceived book should contribute materially to the ultimate fulfillment of the hope expressed by the director of the C.M.O., Dr. Kiyoo Wadati, that the complete atlas "will become the standard work of reference wherever climatological data for Japan is desired."

To attain the greatest possible accuracy, the recorded data of all of the more than 1500 weather stations in Japan were analyzed. Four full-page colored maps portray the absolute maximum depth of snow over Hokkaido, northern Honshu, central Honshu, and western Japan (western Honshu, Skikoku, and Kyushu). The basic isopleth intervals of snow depth are 0, 10, 20, 50, 100, 200, 300, and 400 centimeters, though in certain cases where isopleths are widely separated some intermediate values are shown. Superimposed on these maps are isotherms at 5° C. intervals indicating absolute minimum temperatures. Exactly what correlation is expected to appear between absolute snow depth and minimum temperature is not clear. A similar series of four regional maps, but without isotherms, depict the mean annual maximum depth of snow.

Sixteen additional isarithmic maps relate to snow. These are on a scale that permits the inclusion of all four of the main islands on a single full page. Eight of the maps represent mean maximum depth of snow by months (October through May); the remaining eight show the average dates of the first and last days of appreciable snow (on the ground), the average dates of the first and last days of continuous snow cover, the average duration in days of continuous snow cover, the average dates of the first and last days of snowfall, and the average duration in days of the period without snow. The atlas also includes six maps relating to hoarfrost and the freezing of water. Three maps show for each the average dates of the first and last days of occurrence and the average duration in days of the annual period when these phenomena do not occur.

The rest of the atlas is devoted to graphs and tabulated statistical data that further refine the snow picture. Graphs for 37 stations give snow-cover depths by days for the cold seasons of each of the 15 years 1930-1945. These not only permit a precise analysis of snow-cover conditions in individual seasons but also afford an opportunity to examine the character of the yearly variations. The climatic table provides for several hundred stations absolute maximum snow depths with the dates of occurrence, mean monthly maximum snow depths, and mean daily maximum snow depths.

Both the attractive color scheme and the general readability of the maps make the atlas a most pleasing presentation. One wishes that there were something comparable to it covering the United States, Canada, and Alaska.—JOHN C. WEAVER

WESTWARD EXPANSION: A History of the American Frontier. By RAY ALLEN BILLINGTON, with the collaboration of James Blaine Hedges. xiii and 873 pp.; maps, bibliogr., index. The Macmillan Co., New York, 1949. \$8.50. 9½ x 6¼ inches.

This big book strikes one as a history of the American frontier aimed to end all such histories—a sort of grand fruition of Turner's provocative generalizations about frontiers and sections, as distilled from two subsequent generations of specialized scholarship; or what an indomitable student and able writer could extract from Turner and Merk's "List of Refer-

ences on the History of the West." Billington's critical "Bibliographical Note" runs to 74 pages of small print, and his graphic regional sketch maps number 89. In Section I, "The Colonial Frontier," he includes fur, cattle, mines, and farms but barely hints at the forest frontier and omits the fisheries. In Section II, "The Trans-Appalachian Frontier," he deals with the international problems, the mountain plateau, the Lake plains, the Gulf plains; defines the emergent sections and their shifting pattern; and introduces the mighty solvent of the railroads. In Section III, "The Trans-Mississippi Frontier," he deals with the erasures of Spanish, British, Russian, and Indian barriers; reveals new sectionalisms; and copes with the frontiers of aridity, mining, cattle, and sheep, and the price decline of 1873-1896. He begins his book with an essay on "The Frontier Hypothesis" and closes it with one on "The Frontier Heritage."

So immense and comprehensive a work bespeaks a filial (or perhaps grandfilial, through Frederick Merk) piety toward Frederick Jackson Turner. Billington treats him with greater acceptance than Merle Curti does in his recent essay for the Instituto Panamericano de Geografía e Historia (*Historiadores de América*, II, Mexico, 1949) or Richard Hofstadter in his "Turner and the Frontier Myth" (*The American Scholar*, Autumn, 1949, pp. 433-443). This is not the occasion to argue the case, but it seems permissible to say that although Billington is careful to include the principal qualifications of Turner's hypotheses that have been brought out rather exultantly during the past 15 or 20 years, he gives them distinctly less weight and emphasis than the original challenging generalizations which kept many American historians at work for two generations. It is as though he thought he had detected the beginning of a return swing of the pendulum in Turner's favor and had been unable to resist adding a push.

The great merit of the book is its cumulative effect. By giving a quarter of his space to the colonial frontiers, something that has never before been done so scrupulously and with such unity, the author establishes a dynamic pattern that accommodates subsequent similarities, novelties, and enlargements in scale with great facility. The reader knows that he is viewing a process, and with that accomplished, he need not worry about Turner unless he wants to. He might reasonably ask for more on two aspects of the subject: the leading personalities in the process, and the effects of topography and resources on the direction and location of settlement.

The shocking characteristic of the process is the amount of war, violence, and ignobility it involved. If there is still a need to puncture the myth of peaceful American expansion, this book does it. More than half of it has to be given up to American war, or its equivalents in chicanery and overriding power, against Frenchmen, Spaniards, Netherlands, Swedes, Britons, Canadians, Mexicans, Russians, fellow Americans, and, above all, the North American Indians. Alexis de Tocqueville's "flood of men rising unabatedly and daily driven onward by the hand of God" is a horrifying and sobering spectacle when its ruthlessness over almost three centuries is concentrated between two covers.

The book is lucidly, interestingly, and reasonably written. One might almost add "leisurely," except that a number of errors and oversights in digesting the immense mass of scholarship indicate some haste or impatience. It would have been more satisfying (and no doubt longer) if its scope had not been confined almost exclusively to the continental land mass of the United States. The North Atlantic fisheries formed a frontier. New England expanded into Nova Scotia, expelling the Acadians in the process. The West Indies and the

Caribbean were a frontier, and the Isthmus of Panama another. The swelling population of Quebec, and indeed of eastern Canada, invaded the United States as surely as American miners invaded Canada or American farmers poured into the Canadian High Plains. It is as impossible to make intelligible the War of Independence, the War of 1812, or the Civil War with practically no attention paid to maritime power and interest as it would be to explain the United States in the wars of 1914 and 1939 and the subsequent American frontiers in Western Germany and Japan. Dr. Billington's book already transcends or contradicts the title "Westward Expansion." Perhaps his successor will write of "American Expansion" in its full continental, hemispheric, and global senses. —J. B. BREBNER

RAINFALL AND RUNOFF. By EDGAR E. FOSTER. xix and 487 pp.; maps, diagrs., bibliogr., index. The Macmillan Co., New York, 1948. \$9.00. 9½ x 6¼ inches.

ELEMENTS OF APPLIED HYDROLOGY. By DON JOHNSTONE and WILLIAM P. CROSS. x and 276 pp.; maps, diagrs., ills., bibliogr., indexes. (Series in Civil Engineering.) The Ronald Press Co., New York, 1949. \$5.00. 9¼ x 6¼ inches.

HYDROLOGY. By C. O. WISLER and E. F. BRATER. xi and 419 pp.; maps, diagrs., ills., bibliogr., index. John Wiley & Sons, Inc., New York; Chapman & Hall, Limited, London, 1949. \$6.00. 8½ x 5½ inches.

Hydrology, the youngest accredited member of the natural sciences, has, until recently, depended on periodical literature for the dissemination of its creative knowledge since the second edition of Adolph Meyer's "Elements of Hydrology" was published in 1928. Meyer's work will remain a classic, and if it now fails to meet classroom and engineering-office needs, it is only because hydrology as an applied science has become ambitious to shed its empirical swaddling clothes and assume the garment of mature rationality.

The writer on hydrology has a guide in the hydrologic cycle. If the initial phase is vapor storage in the atmosphere (as suggested in the schematic presentation of the cycle utilized by both Johnstone-Cross and Wisler-Brater from an early work by the late Dr. Robert E. Horton), then the sequence is that of precipitation-producing storms; the return to the atmosphere by evaporation and transpiration of a part of the water thus delivered to the earth; the transient movement of water over and through the ground into stream channels, which ultimately deliver it to the sea; and, finally, storage of the residual increment as ground water.

All three of the works here briefly reviewed embrace the hydrologic cycle, emphasis quite naturally reflecting the specialization of the author or authors. This is not strictly true of the Wisler-Brater work; for a strong influence there is the "posthumous collaboration" of Dr. Horton, to whom the authors pay fitting tribute.

Foster uses his first chapter for the generalization of purpose, definition, and treatment of data, after which he devotes three chapters to meteorology. This emphasis on the initial phase of the cycle detracts somewhat from the value of the work as a teaching text. Although the author does not deal generously with the physical aspects of hydrology, subsequent chapters on precipitation, evaporation, runoff, floods, and ground water are obviously in the hands of a capable statistician who has qualified himself to present his statistics in the light of present-day theoretical knowledge. Foster's work should be welcomed by the graduate student and practicing analyst.

Johnstone and Cross have endeavored to provide the undergraduate teacher with a much-needed text. They have been successful, in a writing style that distinguishes their work, especially for its readability. There is much to commend the arrangement of "Elements of Applied Hydrology," bringing out as it does the distinction between the hydraulics of natural stream flow and the influence of the land and of drainage-basin characteristics on the precipitation-runoff relation.

The student is first introduced to the practical considerations of data gathering and processing, and he is given the satisfaction of working with well-presented illustrative cases. Having described hydrologic "specie," the authors proceed with "hydrologic bookkeeping," which successfully carries forward the analogy between the accountability of water and a balanced bookkeeping system. The same methodical treatment is given flood routing, in which the continuity of flow is made to balance out, with no unaccounted-for dividends or deficits.

Wisler and Brater have also sensed the need to take hydrology into the undergraduate classroom, and within the limits of their book they give a balanced, well-referenced account of terrestrial water. They announce their central theme to be "stream flow, its fluctuations and the causes thereof," and after a brief introductory chapter they go immediately into a discussion of the hydrograph. The student who gets his first impression of applied hydrology from the oversimplified picture of the hydrograph will wonder why he was not led through the intricacies of evaporation and infiltration before being asked to understand the time-rate-of-flow relation in what proves to be a residual element in the hydrologic cycle. The 20 pages devoted to reproductions of the time-area-depth curves prepared by the Miami Conservancy District in 1930 might have been used to better purpose: many additional storms have been processed since this early work, and by procedures benefiting from experience gained through the intervening years. The meteorologist would quarrel with the advocacy of the "station-year method" for fixing the frequency of one-day storms as introduced in the Miami Conservancy District *Technical Reports*. The high degree of "interdependence" between the records at stations so closely spaced makes their treatment as random samples inappropriate.

But these are relatively minor criticisms. Professors Wisler and Brater have been successful in writing a good textbook, and in so doing they have preserved a number of the more important concepts of one of America's outstanding hydrologists, Dr. Robert E. Horton.—MERRILL BERNARD

WEATHER ON THE WEST COAST OF TROPICAL AFRICA FROM 20°N. TO 20°S. INCLUDING THE ATLANTIC OCEAN TO 25°W. 281 pp.; maps, diagrs., bibliogr., indexes. *Gt. Brit. Meteorol. Office* [Publ. No.] 492. His Majesty's Stationery Office, London, 1949. 5s. 9¾ x 6 inches.

This handbook is intended for the use of Meteorological Officers on His Majesty's ships; it is also a helpful reference for geographers, since it summarizes most of the available statistical and descriptive material on the weather and climate of the region.

A summary of the general climatic features is followed by short but detailed climatic studies of seven areas. The remaining three-fourths of the text consists of a discussion of each of the meteorological elements at the surface and in the upper air. This discussion, however, is incomplete; although some synoptic climatology and some notes on local forecasting are included, more emphasis on meteorological aspects of the weather and climate is needed to maintain a better balance with the descriptive and geographical aspects.

References to the new concepts of tropical weather patterns and synoptic sequences introduced during and after the last war are also lacking.

In spite of these deficiencies, the handbook is a valuable source of information, particularly for the many maps, diagrams, and tables it contains. Seventy-one maps and diagrams illustrate the general climatic conditions over both the coast and the ocean. The appended tables include: general climatological tables (with both morning and afternoon observations of some elements) for 30 coastal stations on the mainland and islands; the seasonal diurnal variation of pressure for eight coastal stations and for four sea areas; the percentage frequency of different degrees of visibility for 12 five-degree sea squares and for 22 coastal stations three times a day; mean monthly cloud amount and percentage frequency of different degrees of cloudiness for 36 five-degree sea squares; monthly average number of days with clear and cloudy skies for 14 coastal stations; the percentage frequency of different heights of base of low cloud for eight coastal stations twice a day; monthly frequency of surface wind direction and force for 46 five-degree sea squares and for 13 coastal stations twice a day; and two-monthly figures on wind direction and speed in the upper air for 18 coastal stations. For Freetown and Lagos, tables also give morning and afternoon upper-air temperature and humidity, cloud types and heights, and height of the haze top. These data are based on twice-daily aircraft ascents.

The publications utilized are organized in an extensive bibliography by area and weather element; unfortunately, however, some important sources (for example, aircraft over-the-sea weather reports during the last war) are not included. Ready reference is facilitated by the inclusion of both a subject index and a "geographical" index.

Similar statistical and descriptive material for the east coast of Africa and the Indian Ocean is summarized in another handbook in the same series: "Weather in the Indian Ocean to Latitude 30°S. and Longitude 95°E. Including the Red Sea and Persian Gulf," *M.O.* 451, 1940-1943.—LEO ALPERT

FRIENDLY CHINA: Two Thousand Miles Afoot among the Chinese. By BAILEY WILLIS. xviii and 312 pp.; maps, ill. Stanford University Press, Stanford, Calif., 1949. \$5.00. 9½ x 6¼ inches.

"Friendly China" plunges one into a somewhat unreal world, which seems much farther away than the four decades and a half that separate us from its author's travels. The book is a combination of letters and diary notes written during a scientific expedition in 1903-1904 by the late geologist from Stanford University. Principally it deals with the author's route from Peking via northern Shansi to Sian (Siking), thence over the Tsinling Mountains by a route different from that of Von Richthofen and across the Tapa Mountains to the Yangtze at a point near the gorges. It is a pleasant tale, relating little of great import and differing little from other early travel accounts of China, but it is distinguished by a sympathetic approach to a China which at that time was still regarded with some bitterness by a Western world not yet recovered from the shock of the Boxer uprising. Dr. Willis completed the manuscript shortly before his death; its purpose presumably was to point out that the Chinese people are still our friends and deserving of our friendship. His account does reveal the changelessness of Chinese rural life, and it shows the genuine interest and inquiring mind that characterize all good geographers in the study of an alien culture.—

HEROLD J. WIENS

BRITAIN'S GREEN MANTLE: Past, Present and Future. By A. G. TANSLEY. xii and 294 pp.; ills., index. George Allen & Unwin Ltd., London [The Macmillan Co., New York], 1949. \$5.00. 8¾ x 5½ inches.

Professor A. G. Tansley has long been the *doyen* of British plant ecologists. A pioneer in the field, he took the lead in establishing the British Vegetation Committee, afterward the Ecological Society, and he became editor of the *Journal of Ecology* almost at its inception. In 1939 there appeared his monumental work "The British Islands and Their Vegetation." In that magnificent volume he dealt so faithfully with the contributions of others that there was not enough of Tansley himself. It lacked the broad overall picture that only he could furnish. In "Britain's Green Mantle" he has given the general reader, with no previous botanical knowledge, that broad survey. He sketches the postglacial development of the flora, especially as revealed by pollen analysis of peat beds (including the establishment of the beech, contrary to Caesar's statement, as a pre-Roman native), and traces the influence of successive human invaders and their animals. The treatment of present-day climate is perhaps surprisingly slight, with no reference to critical temperatures, but the clear exposition of the role of rabbits, voles, mice, deer, cattle, sheep, and birds is most helpful in demonstrating that the vegetation is rarely either a climatic or an edaphic climax.

The types of vegetation are then reviewed in turn—oakwoods, the beautiful beechwoods, other woodland, grasslands (shown as resulting chiefly from grazing animals), heath, moor, and bog, and mountain, fresh-water, marsh and fen, and maritime vegetation.

A brief final chapter on the future is concerned mainly with the probable effects of "improving" hill pastures and the "threat" to Britain's green mantle arising from the planting of exotic conifers by the Forestry Commission. In this we miss an appreciation of man's power to create beauty of a new kind in a land where paucity of tree species is largely due to early separation from the continent, and any evaluation of Watson's hypothesis that man is the deciding factor between useless bog and valuable forest. As in his previous books, Tansley is little interested in geographical distributions, and there are no maps. Since there are no references, a brief annotated bibliography would have been most helpful. Some of the 144 photographs have suffered rather severely in reproduction.—L. DUDLEY STAMP

SEISMICITY OF THE EARTH AND ASSOCIATED PHENOMENA. By B. GUTENBERG and C. F. RICHTER. ix and 273 pp.; maps, diags., bibliogr., indexes. Princeton University Press, Princeton, N. J., 1949. \$10.00. 11 x 7¾ inches.

This book occupies a unique place in the literature of seismology. It supplies the only uniform and systematic analysis now available of the great volume of instrumental observations accumulated since the turn of the century.

During the past few decades it has become clear that simple maps of regions in which earthquakes occur or lists of past earthquakes are incomplete, and in many cases practically meaningless, unless data are included on depth of focus and energy released at the source. The authors, who developed the scale now universally used for assigning a magnitude to earthquakes on the basis of instrumental records, have selected their material scientifically with reference to the magnitude, hence the energy, involved. This comprises deep, intermediate, and shallow earthquakes. Thus, for the first time in the history of seismology, truly significant statistics have been distilled from the chaos that previously resulted from

random tabulations of various samples of the estimated million earthquakes per year around the globe.

"Seismicity of the Earth" evaluates the present relative seismicity of the globe, discusses the geographical and geological character of the areas of seismic activity, and correlates earthquake locations with alignments of active volcanoes, gravity anomalies, oceanic deeps, mountain structures, and the mechanism of crustal folding and block faulting. Tsunamis, or seismic sea waves, are discussed, and a list of 450 active volcanoes is included, with latitude, longitude, and date and type of latest reported activity. According to the authors: "All shocks prior to 1946 which have been located are included in regional tabulations. Of great shallow shocks, 98 have been identified for 1904-1947; 361 major shallow earthquakes of less magnitude have been identified for 1918-1946. These are given in separate chronological lists, which are believed to be practically exhaustive. Over 2000 shallow shocks, and about 1000 deep-focus shocks, 266 with magnitude ≥ 7 , have been selected for study because of magnitude or geographical location."

This book bears little resemblance to *Special Paper No. 34* of the Geological Society of America, 1941, and a supplementary paper in 1945, both on the same subject by the same authors. The material has been completely revised, expanded, and reorganized, and, with the inclusion of the statistical data mentioned above, the result is a true classic in the field.—
L. DON LEET

GEOGRAPHY BEHIND POLITICS. By A. E. MOODIE. 178 pp.; maps, index. (Hutchinson's University Library, No. 22.) Hutchinson's University Library [Hutchinson & Co., Ltd.], London, New York, etc. [1949?]. 7s. 6d. $7\frac{1}{2} \times 4\frac{3}{4}$ inches.

The pattern of postwar international politics is slowly taking shape, and at the same time regional economic groups are forming that are likely to assume an even greater significance in the near future. Dr. Moodie's book is therefore all the more welcome; for it is the first English postwar work that sets out to discuss from first principles some of the fundamental problems of current international affairs. In three introductory chapters the author makes clear his attitude on the scope of political geography, the evolution of states, and the influence of geographical factors on the internal political situation of various states. The body of the book deals with interstate relationships, frontiers, communications, and, above all, the pivotal topic of population.

Admittedly this is by no means the whole of what is commonly accepted as the field of political geography, but the topics chosen are particularly relevant to the current problems of Europe. The short chapter on the evolution of states is worth attention; Dr. Moodie is one with Professor S. Van Valkenburg in believing that the successful development of environmental resources depends in the last resort on the suitable, stable, and acceptable political organization of the state. The disastrous experiment in state formation that took place after the First World War is not likely to be repeated, but the influences that prompted the experiment are still with us. There is, therefore, all the more need to examine in a clear and critical light the present manifestations of nationalism.

This book is one of the publisher's "University Library," designed to meet the need of the mature general reader who requires a scholarly introduction to a subject. Dr. Moodie has certainly filled this need for the layman interested in current affairs, but he has also provided a first-class work for the undergraduate who is meeting the subject in a serious way for the first time.—G. J. ELTRINGHAM

HISTORY OF ANCIENT GEOGRAPHY. By J. OLIVER THOMSON. xi and 427 pp.; maps, diagrs., ills., bibliogr., index. University Press, Cambridge, 1948. 42s. 9½ x 6¼ inches.

THE GEOGRAPHIC BACKGROUND OF GREEK AND ROMAN HISTORY. By M. CARY. viii and 331 pp.; maps, bibliogr., index. Clarendon Press, Oxford, 1949. 30s. 9¾ x 6 inches.

In spite of the excellence of the well-known histories of ancient geography by E. H. Bunbury (*A History of Ancient Geography among the Greeks and Romans*, 2 vols., 1st edit., 1879; 2nd edit., 1883) and H. F. Tozer (*A History of Ancient Geography*, 1st edit., 1897; 2nd edit., 1935), Professor Thomson felt the need for a new "comprehensive and critical survey" because "this subject is seldom well understood." Actually the new history is justified not by deficiencies in the old but by special merits of its own and by the progress of research. As a general and readable account it is inferior to Bunbury and Tozer and will not replace them. Its attempts to relate ancient geography to ancient civilization in general are rather far-fetched, and it is written with such compression of detail that the text becomes uninviting and the footnotes cryptic. When the author glides over difficult controversies by remarking, in effect, that some say this and some say that, we receive an impression of superficiality. This is soon belied, however, by the fact that in all the vast material he has handled there are few important mistakes or omissions. For this reason and because of its thorough coverage of research, including the most recent, in its field, it is a valuable contribution.

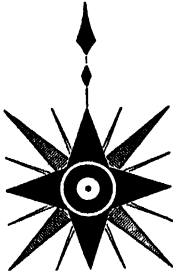
The geography of history is a subject that requires the cooperation of two sciences and may be beneficial for both; for geography can deepen the causative significance of ancient history, while ancient history can lengthen the chronological perspective of human geography. "The Geographic Background of Greek and Roman History" is by a well-known ancient historian, who tells us there has been only one previous comprehensive treatment of the theme. He gives a scientific description of the whole theater of ancient history from Britain to India, with greater detail on Greece and Italy. Topics discussed include terrain, climate, minerals, flora and fauna, agriculture, animal husbandry, and communication, and these are related to ancient economic, military, and political history. Needless to say, the treatment is competent, though more so, in the reviewer's opinion, from the point of view of ancient history than of geography. This might have been a good occasion for co-authorship.—AUBREY DILLER

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The Society's Medals

AT ITS meeting on April 5, 1950, the Council of the American Geographical Society made the following awards of the Society's gold medals: the Cullum Geographical Medal to Hans W:son Ahlmann, the Charles P. Daly Medal to Laurence Dudley Stamp, and the David Livingstone Centenary Medal to Robert Larimore Pendleton.

HANS W:SON AHLMANN. Dr. Ahlmann is Professor of Geography at the University of Stockholm. Although, true geographer that he is, his interests and writings have ranged widely, the problems connected with climatic variation, and particularly the sensitive reactions of glaciers as recorders of this variation, have been his major interest for many years. Not only has he devoted his own attention to the study of these reactions in the glaciers of continental Europe and the Polar Regions, but he has been the inspiration of international cooperation in world-wide glacier study.

LAURENCE DUDLEY STAMP. Dr. Stamp is Professor of Social Geography at the University of London. He is well known for important writings on a wide variety of geographical subjects, and he is also the chief authority on problems of land use in Great Britain. He has been Director of the Land Utilisation Survey of Britain since 1930 and Chief Adviser on Rural Land Utilisation to the Ministry of Agriculture since 1942. In these capacities he contributed much to the increase of food production in Great Britain during the war and has taken a leading part in more recent efforts at town and rural planning for optimum use of the land.

ROBERT LARIMORE PENDLETON. Dr. Pendleton is Principal Soil Technologist, Office of Foreign Agricultural Relations, United States Department of Agriculture, and Professor of Tropical Soils and Agriculture at The Johns Hopkins University. As one of the world's leading experts in soil survey and classification and, particularly, on the nature and use of tropical soils, he has had many years of service as soil technologist and agriculturist with the governments of Gwalior State (India), China, Siam, and the Philippines, as well as more recent experience in Central and South America and Africa.

The Society's Beginnings

This year marks the one-hundredth anniversary of the American Geographical Society's inception. The first steps toward the formation of a geographical institution in New York City were taken in 1850 by George Folsom and others whose names are not recorded. On October 9, 1851, a meeting was held at John Disturnell's "Geographical and Statistical Library," 179 Broadway, at which a constitution was adopted and a board of trustees (later to be known as the Council) was elected. The Society's official birthday as an incorporated institution was May 22, 1852.

In its early years the Society was the only organization of its kind in the United States, though it had nine predecessors in other countries. Until 1871 its name was "The American Geographical and Statistical Society of New York," and about a third of the 200-odd papers read before it during this period bore on censuses and other statistical matters. Although it was recognized as a national, rather than merely a local, institution, it was nevertheless a modest little body. It rented a couple of rooms, for a while in New York University and then in Clinton Hall. During a time of financial stress after the Civil War, Peter Cooper offered it five rooms rent free in the Cooper Union, which it occupied until a five-story house was acquired in 1876. Except for a clerk or two, an occasional librarian, and a draftsman, all of whom served part time, there was no salaried staff (indeed, the staff seldom numbered more than four or five until the turn of the century). The Councilors did most of the work.

For several winters in the mid-fifties a meeting was held every week, and the spirit of youth and exuberance ran high. The members, never many more, and usually considerably fewer, than 500, were businessmen, editors, scholars, preachers, doctors. They met to hear, and often to discuss at length, papers that dealt in the main with travel and exploration in remote parts of the world. Well-known regions such as the eastern United States and Europe were conspicuously neglected, except in the statistical sessions. Frequently resolutions were adopted, or special committees appointed, to support worthy geographical or statistical enterprises. The Society was, in a good sense, a "pressure group." It addressed many a memorial to Congress, or members of the Cabinet, or the State Legislature, and once or twice even to the President of the United States.

In two important respects the Society of the fifties and sixties foreshadowed the Society of today. From the very beginning it maintained a library, and from 1852 on it issued a periodical. The founders regarded the building up of the library as the Society's most necessary task and the collections as its most valuable asset. By 1870 it possessed 10,000 volumes and

2000 maps and was already priding itself on having the best collection of geographical works in the country. The library has since grown nearly thirty-fold. The periodical appeared sporadically. Its entire contents for the first two decades would hardly fill two volumes of the *Geographical Review*, but it contained material of substantial scientific value and literary quality, and it won prestige for the Society.

Today there are a thousand or more professional geographers in the United States. In the fifties and sixties there were only four or five at the most, among them the oceanographer Maury, the Swiss Guyot, professor at Princeton, and Daniel Coit Gilman, professor at Yale and later first president of The Johns Hopkins University. Maury and Guyot were active members of the Society, and Gilman served for a few months in 1860 as paid General Secretary, or head of the staff. Geography was cultivated principally by professionals in other fields—notably geologists and topographical engineers in the government service—and by amateurs. Unquestionably the ablest of the amateurs was Judge Charles P. Daly, who joined the Society in 1855 and was elected President in 1864, to serve for 35 years. Through his interest, scholarship, and sound financial judgment, Daly contributed more to the Society's advancement than any other of its members of the nineteenth century. His masterly annual addresses on "The Geographical Work of the World" not only were erudite and critical but make excellent reading. Such all-embracing surveys would be next to impossible today, so far-flung have the frontiers become along which geographical studies are advancing.

The Society's members in the early days held the meaning of the word "geography" to be self-evident. They did not worry over its definition. They did, however, discuss the nature and value of our subject and the purposes of geographical societies. Dr. Joseph P. Thompson, popular preacher and Vice-President of the Society, in an annual address (1859) expounded the value of geography to the scholar, the merchant, and the philanthropist. To the scholar it provides a means for confirming the accuracy of the Bible and the ancient poets and historians, Homer and Herodotus; to the merchant and philanthropist (the Christian missionary par excellence) it furnishes a rich store of practical information. Judge Daly, in answering (1873) a "distinguished bishop" who had questioned him about the utility of geographical societies, asserted that "their object is not merely to accumulate and disseminate geographical information, for that will, in time, be done by the compiler and cartographer, with the aid of the scientific geographer. Their true sphere of activity is in impressing upon the age the necessity of this work, so vast in its details and so important in its results; in pointing out what is to

be done, to what particular quarter exploration or inquiry should be directed, and the necessity or value of it. Instead of leaving the exploration of unknown lands to be undertaken, as it has heretofore frequently been, in a spirit of romantic adventure, their object has been to press the importance of scientific acquirements and linguistic knowledge upon all who are ready to encounter the toil, the privation, and the peril that are incident to such noble undertakings, that they may bring back what will be honorable to themselves and useful to the world." These words still ring true.

A history of the Society is now in preparation for publication at the time of the Centennial in 1952. It will be a tribute to the men and women who have built the institution on the modest foundations laid so long ago. An important theme will be the work of the Council, the governing body that, throughout, has formulated the Society's major policies. On later pages of this number of the *Review* a list appears of all who have served on the Council. Information regarding any of these men—especially those of the early years—will be deeply appreciated. The history will aim to shed light on the contributions the Society has made to the intellectual development of the city and the nation and to the science of geography, and on the progress of geographical knowledge, as reflected in its activities and publications. Such a task can be undertaken only with enthusiasm not unmixed with humility, and the help of any who are able and willing to give it will be welcome indeed.

JOHN K. WRIGHT

Five Years After

In this fifth summer of the postwar world thoughtful persons everywhere, bewildered and depressed by the trend and temper of the times, might well pause for stocktaking. As some slight contribution toward that end, our present issue surveys certain social, political, and economic developments in widely separated parts of the world—developments representative, to some degree, of the complex changes taking place in both hemispheres.

Italy, North and South

In Sicily, Dr. Jenness recently had the opportunity to view E.R.P. in action, and his report on the progress of the program in general and on various projects is encouraging. The newspapers tell us that in order to publicize E.R.P. "the troubadours of Sicily, who go from village to village with their guitars, now carry E. C. A. posters and sing songs about the Marshall Plan" (*New York Times*, March 27, 1950). But from Dr. Jenness' paper it would seem that before too long visible evidence in the form of new roads, houses, dams, tourist hotels, village centers, and the like will make such publicizing unnecessary, and the less tangible but no less real benefits resulting from land reform, malaria control, and increased employment will also be manifest.

In northern Italy, Dr. Weigend examines the effects of boundary changes on the social structure and economy of the South Tyrol. The Italianization of this area, so long linked both politically and culturally with Austria, is now well established, and the Brenner Pass "has become a connecting link . . . rather than a divide."

In Japan, land reform and land reclamation have formed an essential part of the overall program of the Allied Occupation. On the basis of field studies in the fall and winter of 1948-1949, Professor Trewartha reviews the advances made in these matters. Substantial progress in agrarian reform is evidenced by the elimination of absentee landlordism, the reduction of tenancy to some 13 per cent of total cultivated area, and the corresponding increase in the proportion of resident cultivator-owners. Progress in reclamation has not been so marked, particularly in relation to the overambitious goal set by Japanese government officials, but if various practical adjustments could be made in the character of the country's agriculture, as Professor Trewartha points out, much could still be done to provide additional usable land.

Land Problems in Japan

In South Africa, the difficult position of the Cape Coloured population under the Nationalist party's *apartheid* program has been highlighted by the pro-

posals to alter their franchise in favor of special white representation in Parliament—a proposal that has fortunately been abandoned, at least temporarily (*The Round Table*, March, 1950)—and by the resignation of most members of the Coloured Advisory Council, a nonstatutory body created by the Smuts government in 1943 “to enable the Government to keep in touch with Coloured opinion.” Messrs. Buchanan and Hurwitz’s analysis of the Cape Coloured community—its ethnic, religious, linguistic, demographic, and economic composition—provides a basis for the understanding of future political and social developments in the Union.

In India, planning officials have come to the realization that “from whatever angle the fundamental problem [of land vs. man] is approached, the key seems to lie in the greater use and more efficient distribution of its waters”; hence the concept of the drainage basin as the vital natural unit on which effective planning should be based, regardless of the sectional or local interests that must be compromised. The Damodar Valley Project in West Bengal, described by Mr. Kirk, is the young Indian nation’s first such integrated enterprise. When complete it will embrace, among other things, flood control, irrigation, industrial and domestic water supply, and such important by-products as malaria control and afforestation.

Preoccupation with regional developments, however, should not lead to neglect of advancements in the systematic aspects. In the field of cartography, for example, Professor Tanaka has evolved a new method of representing topography that gives an extraordinarily vivid plastic effect to a contour map without obscuring the character of the contours. The map submitted by Professor Tanaka was a photograph of his original drawing and had to be reproduced by the half-tone process; the excellence of the reproduction (p. 451) owes much to the careful work of the Phoenix Engraving Company. In recent developments in the physical sciences, oceanography is represented by a description of the new seamount discovered in the North Pacific last September by the United States Coast and Geodetic Survey ship *Explorer*; geomorphology by a discussion of two recent works on sand dunes that cast new light on that controversial feature of dune morphology the longitudinal dune; and plant ecology by an illuminating commentary on African vegetation.

W. B. F.

THE RECOVERY PROGRAM IN SICILY*

DIAMOND JENNESS

ONE day last January, while on a seven weeks' visit to Sicily, I walked from my hotel in Syracuse to the ancient Greek theater hewn 2500 years ago out of a limestone ridge about a mile to the north of the city. On the way I passed a small group of men working with picks and shovels and wheelbarrows on what was evidently to be a cutoff from the Catania highway to the Ragusa road. Returning by another route I encountered a second gang of workmen building a viaduct for the same cutoff. Here a wooden sign drew my attention. It was painted in the national colors of green, white, and red in three broad bands forming a shield; three stars in the right top corner and several stripes at the bottom clearly indicated the collaboration of the United States; and large-letter words in the body of the shield, headed by "Republic of Italy," described the project as a "road of circumvallation," stated the amount of money allocated for it, gave the name of the contractor, and added, "This public work is being financed by E.R.P. lire funds."

A few days later I motored about 25 miles inland from Syracuse to see a prehistoric necropolis hidden in a deep limestone ravine. Somehow I took the wrong road, and after creeping two miles down a rough cart track I came upon a construction hut and a gang of about 30 men who were building a concrete flume for a small hydroelectric plant. This project too was being financed by E.R.P. The engineer in charge told me that he had been working on it for six months and would complete it in another three.

It was the same in other parts of Sicily. On the water front of Palermo, a city that was mercilessly bombed during the war, several gangs of men were busily repaving the street and building new quarters for the harbor master. Here were three signs, because the work had been farmed out to three different contractors; the amounts were 30, 90, and 107.5 million lire, or a total of about \$367,000.¹ Prominent on each sign was the customary acknowledgment to E.R.P.

* I should like to thank Signor Fabbio Carapelle and his colleagues in the Opere di Bonifica, Palermo, and Professor Piero Landini and Signora Dott. Giuseppina Niosi of the Institute of Geography, University of Palermo, for help in gathering the data for this paper.

¹ A United States dollar equals about 620 lire.

► DR. JENNESS was formerly chief of the Division of Anthropology of the National Museum of Canada and during the war headed the Inter-Service Topographical Section of the Department of National Defence. In 1949 he retired from government service. The present paper is based on a six months' study of economic and social conditions in Italy in 1949-1950.

All these activities were particularly interesting because the Italian Communist press had been bitterly criticizing E.R.P., charging that the United States was using it to re-establish Italy's war potential and to dump on Italian soil surplus goods America was unable to sell elsewhere. In the parts of Italy proper through which I had just motored there were so few outward signs of E.R.P. operations that I had paid little attention to them, but here in Sicily they were so numerous that I decided to seek more information from official sources.

The opportunity came in Palermo, where the chief of the Sicilian branch of the Department of Agriculture and Forests kindly permitted examination of the maps and files dealing with his organization's four-year land-reform plan. Other officials supplied information on E.R.P. activities in the fields of industry and the tourist traffic. However, to understand the various plans and projects, it is necessary to have some idea of the character of the country and its natural resources.

LAND AND ECONOMY

Sicily is roughly the size of Vermont and has a population of nearly $4\frac{1}{2}$ million. Eighty-five per cent of the island is hilly or mountainous; limestone or some other calcareous rock outcrops in many places; and two-thirds of the land has an impermeable clay or part-clay subsoil, so that rain water pours down the steep slopes in sudden floods which wash away the soil and undermine houses and then stagnates in the lowlands in malarial swamps. Soil engineers estimate that over as much as 70 per cent of the country foundations for houses, bridges, dams, and other structures are insecure, and that eight villages are now so endangered that they ought to be evacuated. As for the swamps, in 1946 they gave rise to 150,000 known cases of malaria, not to speak of the thousands that were not reported. Practically all the rain falls in the autumn and winter, as in other Mediterranean countries. Even then, because of the rapid runoff and the lack of storage basins and aqueducts, many towns suffer from a water shortage; Palermo, for example, shuts off the water supply of its more than 400,000 inhabitants from four o'clock in the afternoon until the next morning.

The island has no coal or other minerals except sulphur and asphalt sufficient to provide a base for industry. Even in Greek and Roman times its forests were not extensive, and today large areas are treeless. So great are the food requirements of the rapidly growing population that wheat, beans, and other crops are being raised on mountain slopes which should be devoted to pasture or woodland, with the result that there is much erosion

and impoverishment of the soil. Most of the cereals and vegetables are consumed locally; for export the lowlands produce citrus fruits, tomatoes, almonds, wines, and olive oil. Scanty pastures mean few dairy animals, and milk, meat, cheese, and eggs are all in short supply. The great majority of the people eat nothing but bread, vegetables, fruits, and a little olive oil—a largely vegetable diet, overabundant in carbohydrates and deficient in fats and animal proteins. It is true that the coastal Sicilians eat a small amount of fish, but little reaches the inhabitants of the interior.

If we add to this gloomy picture of meager resources the destruction of harbors and towns during the war, the disorganization of trade, and the tens of thousands of discharged soldiers and others who are unable to find work, we can form some idea of the magnitude of the task facing any government or organization that tries to put Sicily on its feet economically and raise the desperately low living standard of most of its people.

RECONSTRUCT ON AND DEVELOPMENT PROGRAMS

Aside from assistance to emigration, which has not yet entered the scene, the administrative programs using E.R.P. funds have evolved mainly along three lines: industrial and commercial rehabilitation and development; increase of facilities for the tourist trade; and agrarian reform.

In the first category is the restoration of the harbor facilities of Palermo and other war-damaged ports. A sulphur mine near Agrigento that had been operating uneconomically with antiquated machinery and an undue amount of manual labor has been granted a loan of \$200,000 to purchase a flotation plant from the Denver Equipment Company; and other projects are being considered which might enable Sicilian sulphur to compete with that from other places. Augusta, an important shipping port on the east coast, has received a grant for the purchase of an oil refinery plant from the Texas Company. Small loans have been given to a tomato-canning firm in Palermo and a citrus-fruit establishment near Messina. Then there is the hydroelectric project near Syracuse which I stumbled upon, the "road of circumvallation" outside that city, and small schemes elsewhere. But the greatest project of this kind to date is the building of a huge thermoelectric plant at Palermo, a plant that will produce 300 million kilowatt-hours annually and double the island's supply of electricity. An E.R.P. loan of six million dollars will buy American equipment for its construction. Some of the power is to be used on the railroad line that runs from Palermo to Messina.

Plans for increasing the tourist trade are less well advanced. Each city has been drawing up its own project to submit to the E.R.P. administration



FIG. 1—A new road, built in 1949, from Contessa Entellina to the Cavallaro district. (Photograph by Giuseppe Grassi, Palermo.)



FIG. 2—Interior of a farm laborer's one-room dwelling in the Cavallaro district. (Photograph by Fototecnica Bronzetti, Palermo.)



FIG 3—A large irrigation dam at Gela, recently completed (Photograph by Dante Cappellani, Palermo)



FIG 4—Construction of an irrigation flume at Gela (Photograph by Dante Cappellani, Palermo)

in Rome, but since only eight million dollars has been allocated to this use for the whole of Italy, many of the plans will certainly remain paper projects only. Palermo, being the administrative center of Sicily and its largest—and most severely damaged—city, is considering (February, 1950) a request for money to construct, rebuild, or enlarge 32 tourist hotels; it is hoped that 75 per cent of the cost can be advanced on loan by the Bank of Sicily under an official guarantee, one-third of it to bear no interest. Indicative of modern trends is the fact that all but one of these hotels would belong to the medium-priced category most favored by present-day tourists. The exception is a projected luxury hotel at Mondello, a fashionable summer resort and bathing center near the city.

It is in the field of land reform, however, that E.R.P. will produce its most lasting effects. Government officials, after long and careful study, have mapped out a number of projects in different zones, estimated their approximate costs, and classified them as urgent and nonurgent. For each project there is a four-year plan running from 1948–1949 to 1951–1952, when E.R.P. aid lapses. The total four-year expenditure for the nine urgent projects is estimated at about 43 million dollars. Most of this cost is to be divided between the federal government in Rome and the regional administration in Sicily. Although E.R.P. is to pay only a part, it can justly claim to be the mainspring of the entire program; it is, in fact, assuming most of the cost of the first year.

Below are listed the nine urgent projects, all of which are already under construction.²

PROJECT	AREA <i>In hectares</i>	ESTIMATED COST				E.R.P. ALLOCATION*	
		<i>In millions of lire</i>					
		1948/49	1949/50	1950/51	1951/52	Total	1948/49
Alto and Medio Belice	109,500	834.0	3,613	3,598	3,400	11,445.0	570.750
Borgo Lupo Caltagirone	55,507	475.0	839	..	..	1,314.0	416.000
Basso Belice and Carboi	7,500	150.0	54	50	...	254.0	98.000
Borgo Cascino	8,000	50.5	105	50	90	295.5	43.750
Piana Catania	103,000	1,000.0	2,080	2,170	2,120	7,370.0	487.500
Piana Gela	67,000	660.0	1,143	1,130	910	3,843.0	365.000
Borgo Bonsignore	8,800	431.0	464	295	370	1,560.0	418.625
Borgo Giuliano	5,600	130.0	75	70	70	345.0	115.000
Borgo Fazio	47,000	88.0	...	85	55	228.0	77.750
Total		3,818.5	8,373	7,448	7,015	26,654.5	2,592.375

*In February, 1950.

² A list of the nonurgent projects is on file in the library of the American Geographical Society.

THE FIRST YEAR—AN EXAMPLE

Government officials in Palermo are enthusiastic over the work accomplished during the first year. To them land reform does not mean merely the abolition of latifundia and the proper regulation of crops. It means utilizing to the utmost every square foot of land surface and, equally important, giving workers on the land decent homes (See Fig. 2) and decent standards of living. In some places attainment of this goal necessitates reforestation, in others the planting of windbreaks to check the drifting soil. It calls for drainage and irrigation works, the building of reservoirs and aqueducts to supply towns and villages with water, hydroelectric plants to furnish them with light and power, and roads to connect the country villages with the towns and give the farmer easy access to his markets (Sicily has very few country roads); it calls also for measures to combat malaria, the resettlement of part of the rural population in new homes not too remote from their fields, and more nearly adequate provision for their education and health.

All this may seem rather visionary in a world obsessed by a cold war, but let us take an actual example, the Bonsignore or Lago Borgo project near Agrigento, to which E.R.P. has contributed 418,625,000 lire. Lago Borgo, a shallow lake about two miles long surrounded by swampy land, has long been a breeding ground of the anopheles mosquito, which has made the whole district a malarial plague spot. The lake is being drained, and 8800 hectares (about 22,000 acres) of land reclaimed and supplied with roads and other facilities. The project has been broken down as follows:

Drainage	480 million lire
Windbreaks	25
Stream control	200
Lock and canal	70
Another canal	50
Irrigation channels	300
Roads (22 km.)	360
Village center	75
Total	1560 million lire

In addition to this estimated expenditure of 1560 million lire (about 2.5 million dollars) by the two governmental bodies and E.R.P., the authorities estimate that private funds to the amount of some 600 million lire will be spent. The total should provide for 710,000 working days and give employment to at least 600 men—no small consideration for an island burdened with a heavy unemployment problem. Barring some unforeseen calamity, such as another world war, all the nine urgent projects seem assured of com-

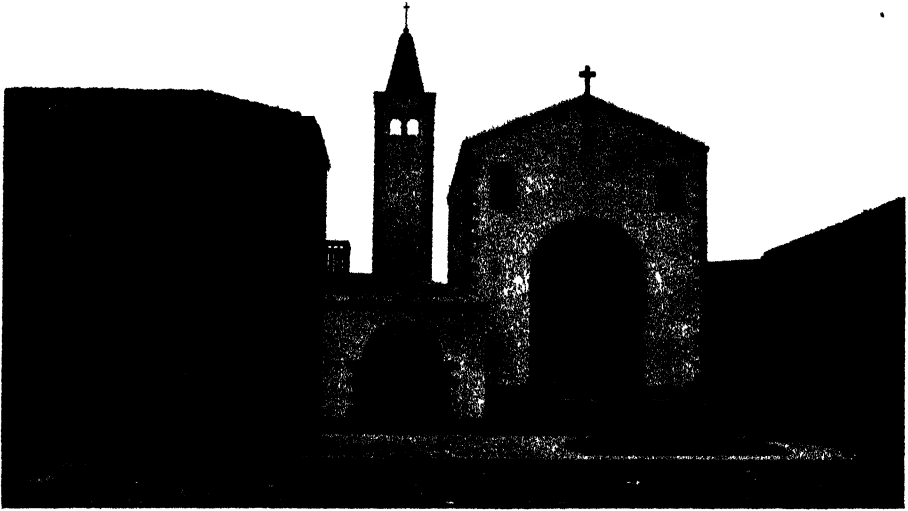


FIG 5 (above)—North end of Cascino village center, with church and presbytery in center, workshops on right, and administrative building on left

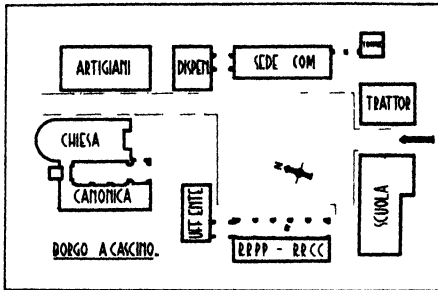


FIG 6 (left)— Plan of Cascino village center, constructed in 1949. See facing page for description of buildings

pletion, whatever changes may take place in the Roman and Sicilian administrations in the next three years.

Larger than the Bonsignore scheme is the one at Gela, on the south coast, another malarial plague spot. Here the project will affect an area of 67,000 hectares (165,600 acres). It includes the construction of 100 kilometers of roads and 70 kilometers of aqueducts, the irrigation of 8000 hectares (20,000 acres) of land, and the establishment of 10 *borghi* or village centers. A large dam has already been constructed (Fig. 3). In building it the contractors had to provide against seepage through the porous chalk rocks, which are clearly visible in the photograph.

Neither the Gela nor the Bonsignore project includes reforestation, but it is a part of the Catania project, which E.R.P. has allocated 487.5 million lire. Here a plantation of *Pinus maritima* has been started; this flat-topped pine was selected because it grows fairly rapidly, conserves moisture well, checks erosion, and provides wood for timber and fuel.

THE BORGO

The *borgo* or village center needs some explanation. For many centuries, perhaps even since the time of the Roman Empire, most farm laborers have lived, not beside their fields, but on the outskirts of towns and large villages, where life was more secure, drinking water was available, and the children could attend school and the family enjoy some social life. Consequently, many a man today leaves his home about five o'clock each morning, rides or drives in his mule cart six or seven miles to his fields, and does not return until dark. To remedy this situation, a small but compact village center will be established nearer the farmlands. Figure 6 shows the plan of the center recently erected in the Enna region at Cascino with the aid of E.R.P. funds. It has the form of a rectangle, with a church and presbytery at the north end (Fig. 5). On the east are shops for repairing tools and machinery, shoeing mules, and so on, a dispensary, a community hall, and, in the corner, a water tower. On the south, flanking the entrance, are a restaurant and a school, and on the west two public buildings, one for the administrative services, the other a combined post office and police station. The buildings are substantial structures of brick or stone.

EFFECTS OF BOUNDARY CHANGES IN THE SOUTH TYROL

GUIDO G. WEIGEND

IN THE thirty years since the boundary shift of 1919 the South Tyrol¹ has undergone certain basic changes in its economic, political, and social structure which illustrate the thesis that a boundary can produce important and lasting effects on an area passing into new hands.² In 1946, at the conference of foreign ministers in Paris, Austrian hopes for recovery of the South Tyrol were disappointed, and the Austro-Italian agreement of September, 1946, which was written into the Treaty of Peace with Italy of 1947, left the boundary unchanged. The question of irredentism was of particular interest. The following observations, giving the writer's impressions of the South Tyrol, are based on field investigations carried out in the summer and fall of 1948.

The boundary between Austria and Italy, as it was established in 1919,³ runs along or near the divide that separates Adriatic and Black Sea drainage. Three times it descends from mountain ridges: at the low passes of Resia (Reschen) and Brenner and at the valley of the Drau (Drava) River. In these places the boundary was superimposed on a culturally uniform landscape. On both sides settlement types, language, customs, and farm organization were similar or alike. Many farmers owned land on the opposite side, and in normal times difficulties of crossing were not great; farmers in the north-eastern South Tyrol were still able to send their herds to their mountain pastures in Austria. In view of the many centuries of the South Tyrol's political unity with, and ethnic relationship to, the Austrian Tyrol, the close ties with friends and relatives on the other side of the border are not surprising, though contacts became weaker as time passed. During and after World War II visiting permits were curtailed, and contacts were, and still are, very few. The important point, however, is not merely change or uniformity

¹ The South Tyrol as discussed in this paper is the pre-1948 Italian province of Bolzano (Alto Adige), not the region to which the name "South Tyrol" is usually applied, i.e. the Italian autonomous region (since 1948) of Trentino - Alto Adige (the former Italian department of Venezia Tridentina), which comprises the two Italian provinces of Trento and Bolzano (see below, p. 370).

² Eric Fischer: On Boundaries, *World Politics*, Vol. 1, 1948-1949, pp. 196-222.

³ For further historical background and other details see G. G. Weigend: *The Cultural Pattern of South Tyrol* (Diss. Ph.D., University of Chicago; also as *Univ. of Chicago Dept. of Geography Research Paper No. 3*), Chicago 1949. See also the bibliography, pp. 190-198.

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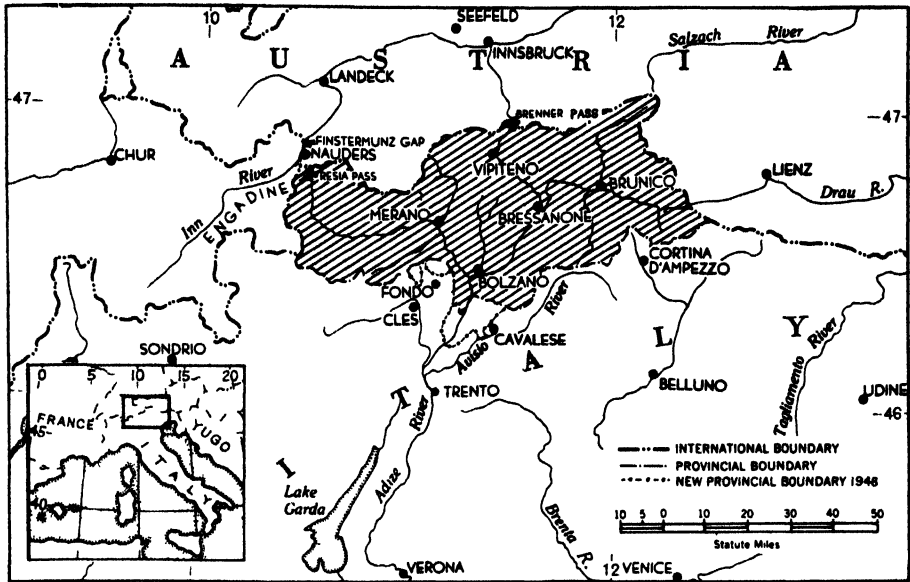


FIG. 1—The South Tyrol.

along the boundary itself, but rather the changes the boundary has brought about in the province as a whole.

POPULATION CHANGES

The population of the South Tyrol consists of three main ethnic groups, speaking three different languages and with distinctive cultures. The Ladins are descendants of the earliest known settlers; they occupy the high valleys of the Dolomites in the southeastern part of the province and have remained a clearly distinguishable entity. The Germans are the largest and most widespread group, a fact that reflects the long development of the South Tyrol under German leadership and domination. Italians are primarily concentrated in counties with urban centers and in rural counties south of the city of Bolzano.

Before 1919 more than 90 per cent of the population of the South Tyrol

TABLE I—POPULATION OF THE SOUTH TYROL ACCORDING TO LANGUAGE*
In percentages of the total

YEAR	GERMAN	LADIN	ITALIAN	YEAR	GERMAN	LADIN	ITALIAN
1910	93	5	2	1939	72	4	24
1921	85	5	10	1943	60	4	36

*Calculated from official and unofficial Austrian and Italian censuses. Percentages are approximate for 1910 and 1939, because the Ladins were counted as Italians in 1910 and as Germans in 1939.

were German and only about 2 per cent Italian (Table I). Population changes since then have been striking. The province had become Italy's northernmost boundary zone, and the Fascist government believed that its Italianization would prevent any future irredentist claims on the area. The population, which had been increasing gradually before World War I, thus began to grow markedly (Table II). The Ladins, who adapted themselves to Italian rule as readily as they had done to German rule, were not affected.

The population increase between 1921 and 1939 was primarily the result

TABLE II—POPULATION OF THE SOUTH TYROL, 1880-1943*

YEAR	POPULATION	YEAR	POPULATION	YEAR	POPULATION
1880	189,288	1921 ^a	235,487	1938	320,168
1890	193,987	1931	269,610	1939	328,408
1900	205,911	1936 ^a	303,306	1943	272,773
1910 ^a	233,169	1937	309,362		

*From unpublished documents (mimeographed) of the Amtliche Deutsche Ein- und Rückwanderestelle, 1939-1942.

^aFrom official Austrian and Italian censuses.

of movements of Italians from the south into the South Tyrol. During the thirties Italy built military highways and fortifications along her international frontier, but the local population were not permitted to participate in the construction. Settlers were brought in from as far away as Sicily and established in both rural and urban areas to work on government and private projects. The chief agency for this resettlement movement was the governmental Ente Nazionale per le Tre Venezie, administered locally from Bolzano. The Ente was authorized to purchase rural and urban property from South Tyrolese and to settle the new Italian population, usually as lessees. It also granted subsidies from its funds to maintain new rural settlers whose farm profits were insufficient for a living and to reinforce the new industries.

Italianization of rural areas was in the main a failure. A large percentage of the Italian farmers who settled in the South Tyrol were from southern Italy. They had moved into this alien cultural and physical environment because of the Fascist government's promises. In spite of financial subsidies, many of them failed; for they were not instructed in the farming methods and techniques peculiar to the South Tyrol. They met with hostility from the German farmers, who regarded them as intruders with a different language, strange customs, and "wrong" ways of farming and resented the help and subsidies they received from the Fascist government. In the end, however, the Germans did accept the few who were able to adapt themselves to local ways of life and overcome the handicaps.

In urban areas Italianization was more successful. Italians from the south

moved into the cities to take over governmental positions and businesses or to work as laborers in newly established industries. The largest influx came to Bolzano, which was 5 per cent Italian in 1910 and between 75 and 80 per cent Italian in 1948.⁴ This mushrooming of Italian population in Bolzano began after the establishment of an industrial zone in 1934 in the southern part of the city.

The sudden decrease in population in the South Tyrol between 1939 and 1943 (Table II) and in part the change in the proportionate strength of Italians

TABLE III—POPULATION (ITALIAN CITIZENS) OF THE CITY OF BOLZANO ACCORDING TO LANGUAGE*

YEAR	ITALIAN	LADIN AND GERMAN	TOTAL	YEAR	ITALIAN	LADIN AND GERMAN	TOTAL
1921 ^a	7,675	17,614	25,289	1939	36,050	22,084	58,134
1936			45,505	1943	50,730	13,803	64,533

*From official and unofficial census statistics. The 1936 census was not broken down by nationalities.

^aIncludes the former city of Gries, incorporated into Bolzano in 1925.

and Germans (Tables I and III) stemmed from the Hitler-Mussolini pact of 1939. In that year Hitler publicly confirmed the Brenner frontier and agreed with Mussolini that the South Tyrolean minority problem was to be solved either by complete assimilation of the German-speaking minority or by their emigration to, and resettlement in, Germany. Any danger of strife between Greater Germany and Italy on the ground of minority demands was thus to be removed. The German and Ladin populations of the South Tyrol and adjacent areas were given the option of voting for German or Italian citizenship. Out of a total of about 230,000 Germans and Ladins in the province (Bolzano), or 250,000 if adjacent areas are included, 178,000 and 189,000 respectively, or about 77 per cent, chose to accept German citizenship and emigrate to Germany before the end of 1942.⁵ Since war broke out shortly after the plan went into effect, only about 70,000 Germans from the province and 75,000 from the entire area (and very few if any Ladins) moved into Germany within the period specified. The movement stopped completely in 1943.

After World War II there arose the serious problem of citizenship for South Tyrolean who had opted to go to Germany under the 1939 agreement, both those who had left and now wanted to return and those who had remained because the war made migration impossible. Of the South Tyrolean

⁴ The Austrian census of 1910 and interview with officials of the Bolzano Chamber of Commerce.

⁵ Interview with officials of the Südtiroler Volkspartei, Bolzano, and unpublished documents (1946) of the Austrian Landesstelle für Statistik und Landeskunde, Innsbruck. There is some variation in figures. For an Italian source, see M. K. G.: *The South Tyrol and Its Future, The World Today*, Vol. 1 (N.S.), 1945, pp. 270-280; reference on p. 276 and footnote.

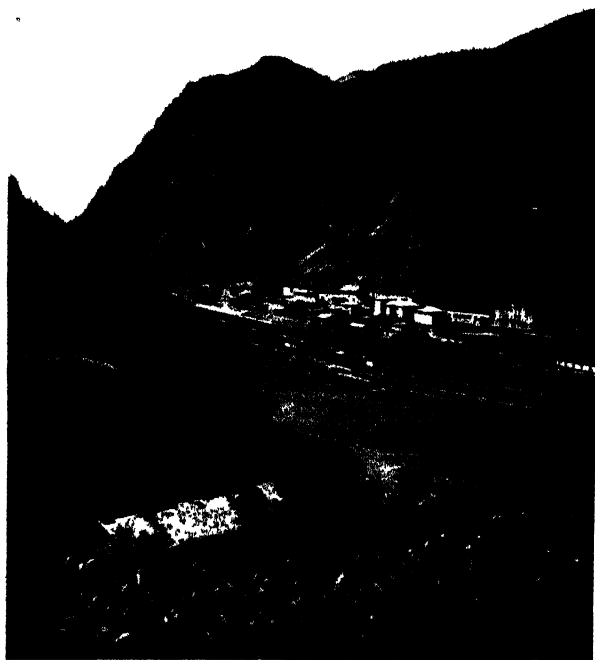


FIG. 2.—The village of Brennero in the Brenner Pass, showing railroad yards.

displaced persons, about two-thirds of them in Austria and the rest in Germany, many have applied to Italian consulates for permission to re-enter the South Tyrol and become Italian citizens. The Italian government is reluctant to grant this permission, because jobs and property left by displaced persons have been taken over by other inhabitants. A decision is given in each individual case, and proceedings are consequently slow. After the war these people had little choice of status, because Austria refused

them citizenship and the International Refugee Organization did not consider them displaced persons under its statutes. The residents of the South Tyrol who lost their Italian citizenship because they intended to emigrate to Germany will undoubtedly regain it in due time.

POLITICAL AND SOCIAL CHANGES

Political and social changes after the boundary adjustment were as significant as population movements. In the first years under Italian sovereignty the South Tyrol fared well. The peace treaty had been accompanied by official Italian promises concerning respect of cultural rights and autonomous administration, and Italy observed these agreements.⁶ When the Fascists came into power, however, the autonomy was nullified, and a policy was inaugurated that had been stated by an Italian spokesman during the peace negotiations in 1919: "A nation has the right to the frontiers which nature has clearly indicated for her. If elements of foreign nationality live within these limits, it is natural that they must become assimilated."⁷ In accordance

⁶ E. Reut-Nicolussi: *National Minorities in Europe: The Germans of South Tirol*, *Slavonic Rev.*, Vol. 16, 1937-1938, pp. 370-385.

⁷ "Austria's Irredenta—South Tyrol," *The Nation*, Vol. 110, 1920, pp. 406-410.

with this attitude, Italianization policies were begun in 1923 that suppressed and terrorized the population both politically and socially. Italians replaced Germans in all public services and in key governmental and economic positions, and laws were passed that affected every aspect of the life and customs of the population. For example, Germans were forbidden to wear traditional costumes, to be christened with German first names, or to belong to social and political groups.⁸

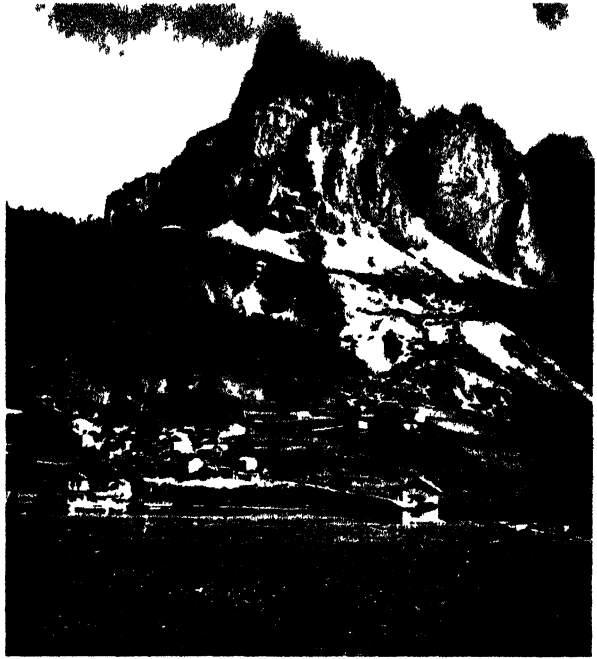


FIG. 3—Ladin village of Pescosta in a high valley of the Dolomites.

One of the long-established laws, the law of primogeniture, accepted and complied with by many farmers in the province, was abolished in 1931.⁹ This act put the South Tyrol on a par with the rest of Italy, where property is divided among family members when the head of the family dies. Land-tenure systems, layout of farms, and farm economy would have changed drastically had not most farmers clung to their tradition by willing their property undivided to one member of the family. Members of a family did sometimes take advantage of the nonexistence of the law and attempt to break the will and receive their portion of the inheritance. Such practices became more widespread after World War II, when inflation gripped the country and cash payments were not so attractive as the security afforded by land, no matter how little.

After the end of the Fascist regime the South Tyrol regained considerable self-determination. In 1948 the South Tyrol (i.e. Bolzano Province) and

⁸ See also E. R. v. Kuehnelt-Leddihn: *Where Three Countries Meet: The Region of Nauders*, *Geogr. Rev.*, Vol. 35, 1945, pp. 239-256; reference on p. 248.

⁹ Primogeniture had been traditional but became a law in 1900. Farmers had to declare whether or not they accepted the law; if they did accept it, they had to follow it until its nullification. Under the law the eldest son inherited the property and the other children were given cash payments.

the adjoining province of Trento became an autonomous region,¹⁰ and certain counties of Trento with a German-speaking population were incorporated into the South Tyrol. The region (Trentino-Alto Adige) has a Council in Trento, the regional capital, which has broad legislative powers. Each province has as its local governing body a diet, empowered to enact laws in fields of activity with local significance. Although the official language remains Italian, use of the German language is permitted in public offices, and all signs may appear in both German and Italian, though never in German alone. Schools remain under national control, as in Fascist days, but the province has a voice in school administration and supervision. Furthermore, teaching is permitted in the mother tongue of the students by a teacher having the same mother tongue. A certain amount of Italian in the curriculum is required in the German-language schools. Also, the population has again been allowed to resume old and established customs that the Fascists attempted to eradicate.

The autonomy statute has thus restored to the population of the South Tyrol, particularly the Germans, a degree of political and social freedom that they have not had since the advent of the Fascists. The period of Fascist domination was a political and social void, but the process of economic integration into Italy has been continuous and in the end beneficial.

CHANGES IN THE ECONOMIC ORGANIZATION

The transfer of the South Tyrol from the Austro-Hungarian Empire to Italy destroyed the economic equilibrium of the province. However, even if it had remained within the new Republic of Austria, its economy would still have suffered heavily, because of the dismemberment of the old empire. The marketing of fruit and wine, chief commercial products of the province, had been no problem before World War I, when there was an almost unlimited market for them in parts of the empire to the north. The new Brenner frontier seemed at first a formidable barrier, on account of the competition with other Italian fruit and wines. The problem was solved by improving the quality of the local products and thus increasing their desirability on foreign and domestic markets. Before World War II about four-fifths of the fruit and nearly all the wine were exported, chiefly to Central Europe.¹¹

¹⁰ Regionalism is "an integral part of the new Italian Constitution." See B. C.: Regionalism in Italy: An Experiment in Decentralization, *The World Today*, Vol. 5, 1949, pp. 81-92; reference on p. 81. Other regions with special autonomy are Sicily, Sardinia, Valle d'Aosta, and Friuli-Venezia Giulia.

¹¹ Export figures are available from 1932 to 1941 for fruit, and 1934 to 1939 for wine. See Weigend, *op. cit.*, pp. 146 and 147.



FIG. 4—Farmhouse in the village of Resia, with community well in foreground.

FIG. 5—A farmer of the upper Sarentino valley and his wife in Sunday dress. Rocks on roof of farmhouse weight shingles.

FIG. 6—Cornedo Castle, near Bolzano.

FIG. 7—Newer section of Bolzano, constructed after 1919.

FIG. 8—A farmer carries his harvest load from field to barn on a high valley farm.

FIG. 9—Gorge in one of the valleys tributary to the Isarco, with highway hewn out of cliffs.



FIG. 10—Winding highway connecting Merano and Vipiteno, looking northeast from Giovo Pass.

In rural areas other than the fruit belt farm economy adjusted to the needs of the Po Plain, wherever practical. For example, there is a constant demand in the Po Plain for seed potatoes and Swiss brown cattle, which cannot be bred there. Farmers in the South Tyrol therefore began to raise, successfully, seed potatoes imported from northeastern Germany¹² and brown cattle imported from Switzerland.

The South Tyrol had been far from self-sufficient as a part of the Austrian Tyrol, but it could draw on the rest of the empire for such supplies as meats, fats, vegetables, and wheat, none of which Austria was able to furnish. With the boundary change the South Tyrol became wholly or partly dependent on Italy for these and other necessities. Under Fascist rule all purchases and sales throughout the country had to be made through the *Consorzio Agrario*, a quasi-governmental wholesale organization obligatory in all provinces, which kept strict controls over the buying and selling of agricultural products. Now other agricultural organizations also exist and membership is entirely voluntary, but the Tyrolese tie with Italian economy and the dependency on it remain.

Industrially the South Tyrol was little advanced until it became a part of Italy. Before World War I most manufacturing was strictly of the workshop type, and much of the hydroelectric-power potential had not been harnessed. After the war electric-power companies were founded¹³ which undertook to utilize that vital resource. With some exceptions large-scale

¹² Importation of seed potatoes from East Prussia stopped during the war and has not been resumed. Since the war all potatoes have been raised locally.

¹³ A comparison of power-production figures before and after World War I is given in "The Italo-Austrian Frontier and Annexes Thereto," an unpublished document presented by the Italian government (*Ministero degli Affari Esteri*) to the Council of Foreign Ministers, June, 1946, pp. 10-12.

manufacturing was not begun until the establishment of an industrial zone in the city of Bolzano in 1934.

Capital from the great metropolitan centers of northern Italy and labor from northern and southern Italy were imported into the province for construction and operation of power projects and industries. The local German population was excluded from all these activities, and for that reason many German-speaking, and some

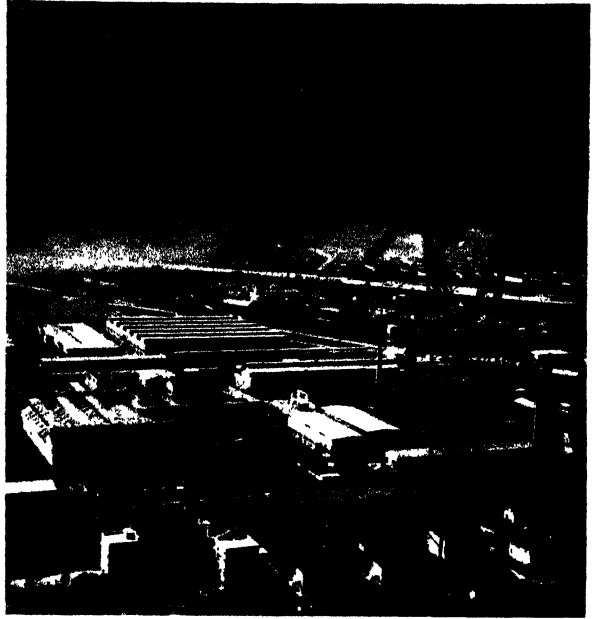


FIG. 11—Section of Bolzano Industrial Zone, with steel mills in foreground

Italian-speaking, residents interviewed in the South Tyrol expressed the conviction that the Industrial Zone had been located in Bolzano not for the ostensible purpose of utilizing local hydro-electric power and lumber in the battle for national self-sufficiency but to accelerate the Fascist Italianization of the South Tyrol. Table III lends support to that conviction.

Many of the companies in the zone, however, were planned to fill a definite gap in the Italian economy. For example, the *Industria Nazionale Alluminio* contributes roughly one-third of Italy's aluminum production, and the *Società Anonima Industria Magnesio e Leghe di Magnesio* is reported to manufacture Italy's entire supply of magnesium and magnesium alloys. In 1948 an estimated 5500 workers were employed in the Industrial Zone, nearly all of whom were immigrants from other Italian provinces.

The generally most profitable source of income for the South Tyrol, the tourist trade, suffered most and recovered slowest after the incorporation of the province into Italy. Hotels, farms, transportation, entertainment, and restaurants were affected. Before World War I tourists from within the empire and from countries to the north came to the South Tyrol the year round to enjoy the scenery and the pleasant climate. After the war border restrictions, financial difficulties, and other effects of the war reduced the number of foreign tourists. The number of tourists from other parts of Italy increased,

but their season was for the most part crowded into a little more than two weeks in August and a shorter period in July. Furthermore, marked paths in the mountains and mountain refuges were not maintained so well by Italian tourist organizations as they had been by German clubs, because most Italian tourists in the province preferred to stay close to their hotels. Other efforts were made to attract tourists and rejuvenate the trade, such as the construction of aerial cable cars and chair lifts, which took tourists or skiers from the valley floor to high mountainous terrain in a few minutes. Existing

TABLE IV—TOURIST TRADE IN THE SOUTH TYROL, 1933-1948*

YEAR	ITALIANS	FOREIGNERS		TOTAL
		NUMBER	%	
1933	134,086	150,206	53	284,292
1934	190,638	181,587	49	372,225
1935	212,767	200,925	49	413,692
1936	218,539	231,605	52	450,144
1937	241,773	322,814	57	564,587
1938	265,401	316,344	54	581,745
1939	272,064	183,976	40	456,040
1945	77,410	31,717	29	109,127
1946	151,696	15,414	9	167,110
1947	192,025	28,173	13	220,198
1948	180,688	38,555	17	228,243

**Mitteilungen der Handels- Industrie- und Landwirtschaftskammer Bozen*, Vol. 2, 1949, p. 34.

highways were improved, new roads were constructed, and railroads were electrified. Nevertheless, the total number of tourists decreased from more than one million annually before World War I¹⁴ to 284,000 in 1933—a result not only of the boundary shift but of the general economic instability.

Hardest hit were the cities of Bolzano and Merano. Gries, a section of Bolzano, and Merano had capitalized on their protected locations and high percentage of winter sunshine to become resort towns and meeting places for the high society of the Austro-Hungarian Empire. The drastic postwar changes in the social system of the former empire and of Germany diminished the clientele of nobility and commoners alike who could afford to stay in luxurious hotels. Gries was eliminated as a resort in the middle thirties when the Industrial Zone was established in Bolzano and reduced the city's touristic desirability. Merano, however, made an attempt to regain its former status. A race track was built within the city limits, but races increased the number of visitors for only very short periods; for regular racing schedules Merano was too far from the large Italian cities. A gambling casino was likewise a futile attempt to attract tourists, and World War II added to the city's predicament, not because of destruction but because of depreciation and loss as a result of Italian, German, and Allied military occupation.

¹⁴ Fritz Dörrenhaus: *Das deutsche Land an der Etsch*, Vienna, 1933, pp. 139-140.

From 1933 until World War II tourist trade in the South Tyrol improved continuously. Although it did not become a year-round business, it was well on the way to recovery. The war brought another setback, but in 1948 and 1949 many border restrictions between Italy and other nations were lifted; barring international political complications, the way to full rehabilitation of the trade was thus opened.

THE PRESENT OUTLOOK

Since establishment of the new boundary in 1919, South Tyrolean economy has become adjusted to, and integrated with, the economy of Italy. The German-speaking inhabitants, even though culturally bound to their neighbors in the north, in general feel that economic adjustment and integration have gone so far that a revision of the boundary would be a shattering blow. There are a few who agitate actively for annexation to Austria, but they are mainly those who remember the South Tyrol as part of the glorious Austro-Hungarian Empire and think that their position could become as favorable again. Most of the Germans, and also the Ladins, are satisfied with their present political and economic status. They have a regional autonomy, which means that they have a voice in their local government and that their cultural heritage is being respected. Some of the younger people interviewed stressed the futility of irredentist movements from within or without the South Tyrol—and mostly they are from without. Even the program of the largest political party, the German Südtiroler Volkspartei, drawn up in November, 1947, states that "the aim of the Südtiroler Volkspartei is to ensure and promote, within the bounds of the Italian state, the individuality of the ethnic, economic, and cultural life of the people of the South Tyrol, and to restore or create the necessary bases for such a program."¹⁵

Certainly Austria's impoverished economy would profit from the restoration of the South Tyrol. Fruit, wine, manufactured products, and, particularly, the tourist trade would enrich the depleted finances of the country and make possible a somewhat better economic balance. Recent talk of boundary revisions has been based principally on such considerations and on emotional grounds. The Brenner boundary has in effect tied the South Tyrol to the rest of Italy by orienting the flow of hydroelectric power and industrial and agricultural products to the south; at the same time a lucrative export business is sending goods to the north. In other words, the Brenner Pass has become a connecting link between Italy and Austria rather than a divide.

¹⁵ "Programm der Südtiroler Volkspartei." (Typewritten document in the files of the Südtiroler Volkspartei, Bolzano.)

LAND REFORM AND LAND RECLAMATION IN JAPAN*

GLENN T. TREWARTHA

LAND reform and land reclamation are important elements in the general plan of the Allied Occupation in Japan for creating a more democratic and, if possible, a more economically sound national structure. Reform of the land system has been aimed primarily at the stabilization of agriculture and the removal thereby of one of the specific underlying causes of war. It was hoped by many and believed by some that land reform would also increase agricultural output. The land-reclamation program, on the other hand, was largely inspired by economic considerations and has as its goal improvement in the land situation; only incidentally is it associated with the general reform phase of the Occupation.

Agriculture has been in the past, and will probably continue to be, the backbone of the Japanese national economy. The phenomenal expansion in industry and trade between the two World Wars did not change the ranking position of agriculture. It normally employs 40-45 per cent of the population and supplies 80-85 per cent of the country's food requirements; before World War II it represented nearly half of the nation's invested capital, and it is the only part of the Japanese economy that has survived the war in a relatively good position. If Japanese agriculture were as prosperous and healthy as it is important to the economy, it would be in a flourishing state indeed; however, even in normal times rural Japan presented a picture of frugality, impoverishment, economic distress, and social unrest.

HISTORICAL BACKGROUND OF THE LAND-TENURE SYSTEM¹

Too little tillable land and too many people has been the cause of most of the woes that have beset agriculture in Japan, including the land-tenure system that has prevailed for nearly three-quarters of a century.

* Acknowledgment is made of the assistance rendered by the Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Tokyo, in collecting many of the materials contained in this paper. Valuable suggestions and criticisms were also offered while the paper was in the preliminary stage.

¹ In the sections on the land-reform program free use has been made of Laurence I. Hewes, Jr.: On the Current Readjustment in Japanese Land Tenure, GHQ, SCAP, January 14, 1949. Later published in *Land Economics*, Vol. 25, 1949, pp. 246-259. Mr. Hewes has also made a more comprehensive report on the subject: "Japanese Land Reform Program," *Natural Resources Section Rept. No. 127*, GHQ, SCAP, Tokyo, March 15, 1950.

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Throughout its history Japan has been a land of individual landholdings—small plots of “garden” dimensions cultivated by single families. During the long feudal period before 1868, although the economic condition of the peasant was often wretched, he nevertheless enjoyed a certain security of tenure. The Meiji Restoration in 1868 freed the peasants from their serfdom, but the degree of security afforded by the feudal system was destroyed by the introduction of individual landownership and legal alienation through sale. At the beginning of the Meiji period most of the peasants were nominally freeholders. However, as a result of the emancipation of the land from feudalism and the introduction of a money economy, the number of tenants increased rapidly, and by 1892 nearly 40 per cent of the agricultural land was operated by tenants who had formerly been landowners.² The rents paid by tenants were so exorbitant that many new landowners preferred to derive their incomes as absentee proprietors of tenanted land rather than undertake personal management. Thus an exploitive system of tenancy became securely fastened upon the country.

The terms of the tenant-proprietor contract were notoriously harsh. The shortage of agricultural land and the dearth of alternative occupations resulted in a lack of bargaining power on the tenant's part, so that he was obliged to submit to extortionate rental rates and other oppressive conditions. The terms of the lease rested on a generally vague and usually oral agreement. Riceland rents were almost universally paid in kind and as a rule amounted to 50 or 60 per cent of the crop; it was not unusual for the tenant to receive only 30 per cent as his net share. On other types of land rents were more commonly paid in cash. The only responsibilities assumed by the proprietor were to supply the land and pay the land tax. The tenant took all the risks and paid most of the expenses, including some of the taxes; he furnished the house and other farm buildings, implements, seed, and so on. The rental was a fixed charge based on yields in good years. In poor years the tenant was in desperate straits, and the landlord frequently became a creditor demanding usurious rates of interest. According to official sources, the average rate of interest on farm loans in 1932 was nominally 12 per cent, but actually it was much higher, probably between 20 and 30 per cent. The situation was most serious with tenants who rented from landlords with estates of only 5 to 10 acres; too often it was necessary to support both landlord and tenant on an impossibly small acreage. During the 1920's and the early 1930's the tenant's plight was aggravated by frequent collapse in rice prices, and in some years many farmers were obliged to sell rice and

² E. H. Norman: *Japan's Emergence as a Modern State* (Institute of Pacific Relations Inquiry Ser.), New York, 1940, p. 147.

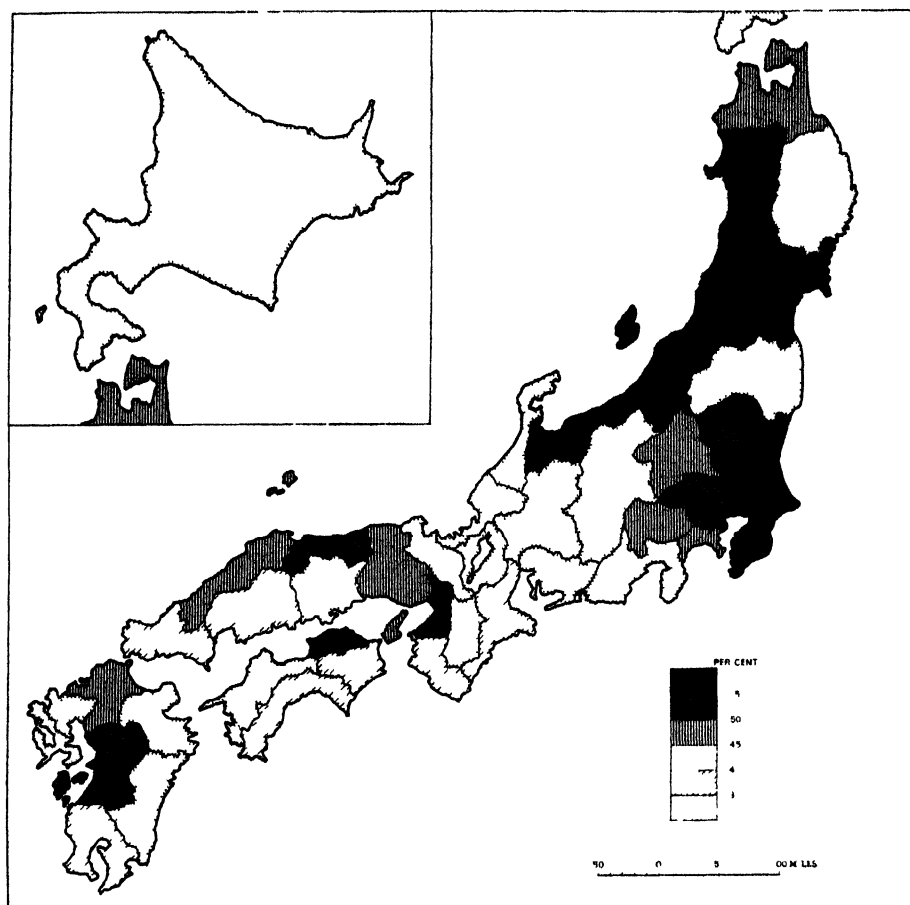


FIG. 1 - Percentage of cultivated land operated by tenants, by prefectures, 1944. Source of data, 'Farm Tenancy in Japan,' *Natural Resources Section Rept. No. 79 GHQ, SCAP Tokyo, 1947*

other crops below cost. This worsening of the tenants' situation is reflected in the greatly increased number of landlord-tenant disputes—from 408 in 1920 to 5512 in 1935.³

By the 1920's the condition of the several million tenant farm families was so serious that the national government was spurred to attempt remedial measures, but these accomplished little. During the 1930's, when a political-minded military group was gaining control of the Japanese government, military and agrarian interests drew closer together. Many of the younger army officers were from rural areas and had personal knowledge of the tenants' distress. Possibly the farm group felt that the acquisition of new

³ W. Ladejinsky, *Farm Tenancy and Japanese Agriculture*, *Foreign Agriculture*, Vol. 1, 1937, pp. 425-446, reference on p. 438

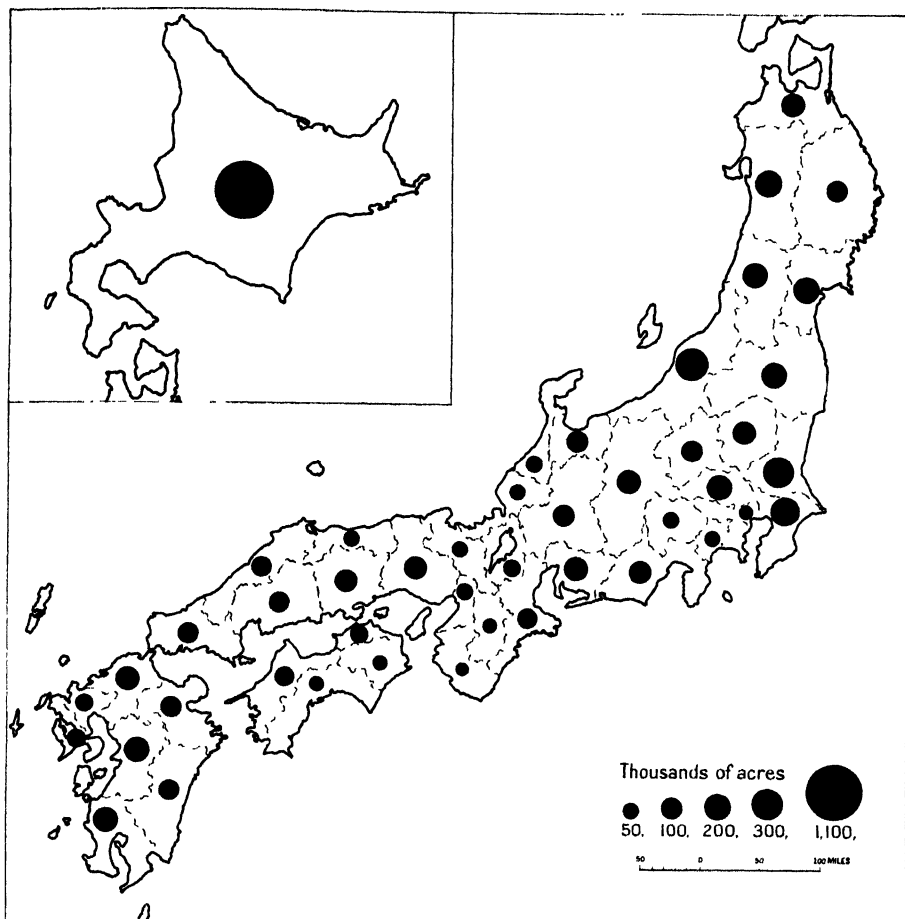


FIG. 2.—Cultivated land operated by tenants, by prefectures, 1939. Source of data, *Normsho Tokeshyo* [Statistical Yearbook of the Ministry of Agriculture and Forestry], Tokyo, 1939

lands abroad resulting from the projected conquest of East Asia would ease the agricultural situation at home. Or there may have been a deliberate attempt on the part of the military to exploit the agrarian discontent. In any case, the poverty and distress of the rural areas, in part associated with the evils of the tenancy system, were at least indirectly responsible for the success of the Japanese war party. It was only natural, then, that reform of the land-tenure system should become one of the primary objectives of the Allied Occupation.

DISTRIBUTION OF FARM TENANCY

The distribution of farm tenancy is shown in Figures 1 to 3. In the immediate prewar period and during the war the proportion of the agri-

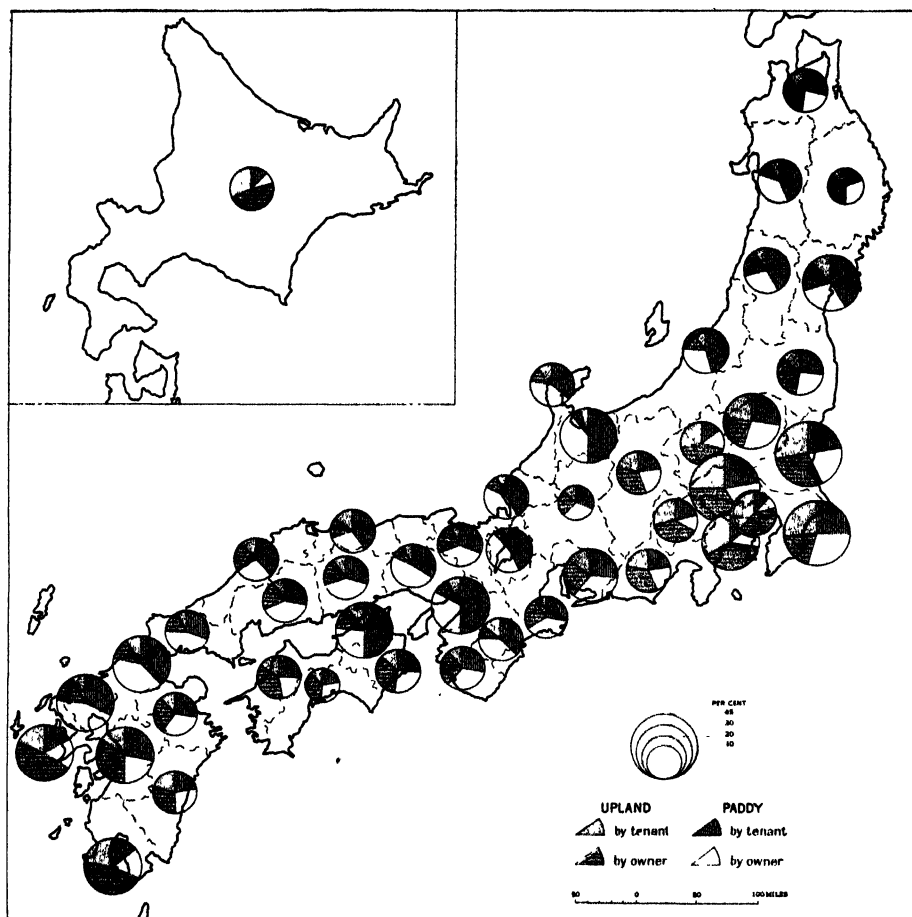


FIG. 3—Cultivated land as a percentage of total area, by prefectures. The percentage of upland and paddy land operated by tenants and by owners is also shown. Source of data, *Norinsho Tokeihyo*, 1939.

cultural land operated by tenants was about 47 per cent, ranging (1944) from 33+ per cent in Nagasaki prefecture in western Kyushu to almost 60 per cent in Miyagi prefecture in northern Honshu. Understandably, tenancy is concentrated on the highly cherished paddy lands (Fig. 3); tenancy on paddy lands and uplands is in the ratio of about 7 to 5. Patterns of distribution, however, are not well defined. Higher than average tenancy seems to be characteristic of most of the prefectures in which the proportion of paddy land is high (Fig. 3). This is clearly observable in a cluster of contiguous prefectures fronting on the Japan Sea in western north Honshu. Here the poorly drained plains are highly specialized in rice culture. The largest number of prefectures with lower than average tenancy are in southwestern Japan, but it is to be noted that in this same general region there are other

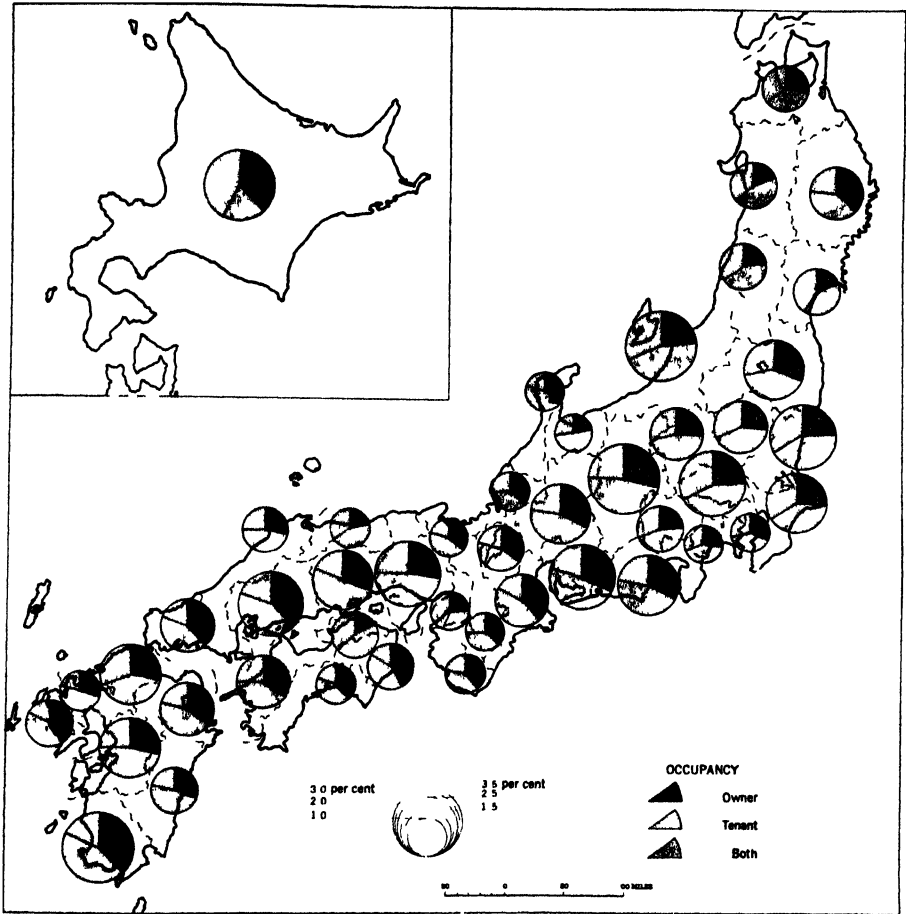


FIG. 4—Percentage of farm households and status of occupancy, by prefectures, 1939. Source of data, *Normsho Tokeihyo*, 1939.

prefectures with very high percentages—Osaka and Kagawa with more than 55 per cent, for example.

Figure 4 attempts to show the distribution of tenancy in terms of farm households. In 1939 only about 32 per cent of the farm households owned their land; 40 per cent were part owners—part tenants; 28 per cent were wholly tenants. In Hokkaido the part owner—part tenant group is unusually small. In this region of later settlement and larger farms there has been less need for increasing the area of land worked, by renting additional plots. Throughout the rest of Japan it is the proportion of complete owners or of complete tenants that varies most. Owners are proportionally lower than average, and tenants higher, in all the prefectures of Tohoku (northern Honshu) except Iwate. The discrepancy is greatest in the prefectures with a

high proportion of riceland, such as Akita, Yamagata, and Niigata in the west and Miyagi in the east. The proportion of owner families appears lower than average also in the general Kanto area and in Osaka, Kagawa, and Tottori prefectures in southwestern Japan.

THE LAND-REFORM PROGRAM

A necessary part of the Occupation's agrarian program has been a drastic reduction in the amount of farmland controlled by absentee land-owners and a parallel increase in the amount of owner-operated land. This has required the transfer of large amounts of privately owned land to tenant-farmers at prices they could pay. Effective control of the landlord-tenant relationship in any remaining tenant-operated land and safeguards to prevent a reversion to tenancy of newly purchased owner-operated land were additional aspects of the Occupation's land-reform policy.

THE LAND-REFORM LAW

The details of the program were worked out by the Japanese, and the required legislation was passed by the Japanese Diet in 1946. The more important provisions of this legislation may be summarized as follows:⁴

1. *With reference to land purchase.* "The government is authorized to purchase the following land:

"(a) All 'tenant-farmer' land [i.e. land cultivated by a tenant] whose owners do not reside in the city, town or village in which the land is situated.

"(b) All 'tenant-farmer' land in excess of 1 cho [2.45 acres] (4 cho in Hokkaido) owned by residents of the city, town or village in which the land is situated. . . .

"(c) All 'owner-farmer' land [i.e. land cultivated by an owner] owned by cultivators in excess of 3 cho (12 cho in Hokkaido) unless it can be proved that the owner has sufficient family labor to cultivate efficiently a greater area or unless subdivision of the larger area would result in decreased production. In addition the government may purchase (1) agricultural lands owned by juridical persons whose agricultural land is not required for its principal purpose, (2) agricultural land not in use or which is being mis-used or ineffectively used, (3) non-agricultural lands adjacent to agricultural lands whose use is essential to operations on the agricultural land. In addition to agricultural land, purchase authority extends to water rights, trees, buildings, and equipment."

The purchase price of land, established by law, is subject to variation within legal limits at the discretion of the land commission. The sale price is paid in the form of 24-year annuity bonds bearing an interest rate of 3.65 per cent.

2. *With reference to land sale.* The government is authorized to sell land to eligible persons selected by elected land commissions in villages, towns, and cities. The tenant who

⁴ Based mainly on Hewes, *On the Current Readjustment in Japanese Land Tenure* (see footnote 1, above), pp. 14-16 (*Land Economics*, pp. 252-253).

has been the established cultivator as of November 23, 1945, on a specific tract has first priority in the acquisition of that tract. The sale price to the purchaser is usually the same as the price paid by the government to the original owner. The purchaser may pay either in cash or in installments over a 24-year period at 3.2 per cent interest. Liens and encumbrances may not be created against lands purchased from the government.

3. *Other regulations on land transactions.* Rental ceilings have been established at 25 per cent for paddy fields and 15 per cent for upland fields.⁵ All leases must henceforth be in writing. No transaction involving agricultural land shall be undertaken without the prior approval of the government land commissions.

ACCOMPLISHMENTS OF THE LAND-REFORM PROGRAM

In 1945, at the end of the Pacific war, 54.2 per cent of the farmland was tilled by owners, who represented 32 per cent of the nation's 5½ million farm households, and 45.8 per cent⁶ was tilled by tenants or part tenants, who represented respectively 28.2 and 39.8 per cent of these households.⁷ About 7.5 per cent of the landowners owned 50 per cent of the land, whereas 50 per cent of the landowners owned only 9 per cent of the land. By the middle of 1949 the transfer phases of the land-reform program were practically completed (Table I). Nearly 4,600,000 acres of land had been purchased by the government, and 4,460,000 acres of it had been resold to owner-farmers. More than 27 million tracts of land have been transferred—more than one-third of all the agricultural land of Japan. A minimum of 2.7 million new owners possess agricultural land. Tenancy has not been entirely abolished, but it is estimated that "tenant-farmer" land retained by resident landlords will amount to only about 13 per cent of the total cultivated area, a reduction of 34 per cent. Absentee landlordism has been completely eliminated, and the proportion of resident cultivator-owners has been considerably increased (Table II). These changes greatly affect the distribution of income from more than two million farms. In terms of paddy land alone, about 55 million bushels of rice that formerly went to landlords is now retained by the new owners. There has been a large increase in the owner-farmer families and a corresponding decrease in the tenant and part-tenant families.

Figure 5 shows graphically the results of the land-reform program as late as October 2, 1948, when purchase was nearly 90 per cent complete. In only two prefectures, Ibaraki (in the Kanto area) and Osaka, did the gov-

⁵ At the present time, under a separate order, they are set at a considerably lower rate.

⁶ Includes all land under tenant operation whether cultivated by tenant or by part owner.

⁷ From "Farm Tenancy in Japan," *Natural Resources Section Rept. No. 79*, GHQ, SCAP, Tokyo, 1947, p. 50.

ernment's land purchase amount to more than 35 per cent of the total agricultural area. In general, the proportions of land purchased are somewhat higher in the prefectures of central and northern Japan than in those of the southwest, but there are exceptions. As might be expected from the national ratio, in a majority of the prefectures purchases of paddy land exceeded

TABLE I—PROGRESS OF LAND TRANSFERS AS OF JULY 2, 1949*

In thousands of acres

STATUS	CULTIVATED LAND	PASTURE LAND	RECLAMATION LAND	TOTAL
Acquired by purchase or transfer	4,595	591	2,775	7,961
Sold	4,462	419	316	5,197
Awaiting disposal	133	172	2,459	2,764
To be purchased (estimated)	Negl.	100	{ 2,450	3,050
To be acquired by transfer (estimated)	Negl.	500		
Percentage completed of total government monetary obligations to landlords for land bought	77.3	5.2	38.8	75.7
Percentage completed of total tenant monetary obligations to government for land sold	84.0	22.0	46.4	83.8
Percentage of purchased area registered ^a	12.4	2.6	ND ^b	ND
Percentage of sold area registered	3.3	0.2	ND	ND

*Source: Ministry of Agriculture and Forestry.

^aData are as of September 1, 1949, and cover 39 prefectures only. Source: Eighth Army, Civil Affairs Section

^bNo data.

TABLE II—ESTIMATED CHANGES IN DISTRIBUTION OF OWNERS AND CULTIVATORS BY CLASSES*

In percentages

OWNERS	AUG. 1, 1947	DEC. 31, 1948	NET CHANGE	CULTIVATORS	AUG. 1, 1947	DEC. 31, 1948	NET CHANGE
Absentee	11.2	0.0	-11.2	Owner-farmer	36.5	70.0	+33.5
Resident				Part owner	20.0	22.5	+2.5
noncultivator	3.3	2.97	-0.33	Part tenant	16.8	2.0	-14.8
Resident				Tenant	26.7	5.5	-21.2
cultivator	85.5	97.03	+11.53	Total	100.0	100.0	
Total	100.0	100.0					

*Source: Hewes, *On the Current Readjustment in Japanese Land Tenure* (see footnote 1, above), pp. 22 and 24 (*Land Economics*, pp. 256 and 257).

those of uplands. It is chiefly in Hokkaido, the Kanto area, and southern Kyushu that the proportions of upland purchased are as high as, or higher than, those of paddy land.

It is still too early to make any comprehensive appraisal of the effects of the land-reform program on agricultural productivity in general. Pride of ownership may well lead to better husbandry, and this in turn to increased quantity and improved quality of output. Opponents of the program have warned of the danger of diminished production associated with a shift in landownership and have cited the example of Puerto Rico. In

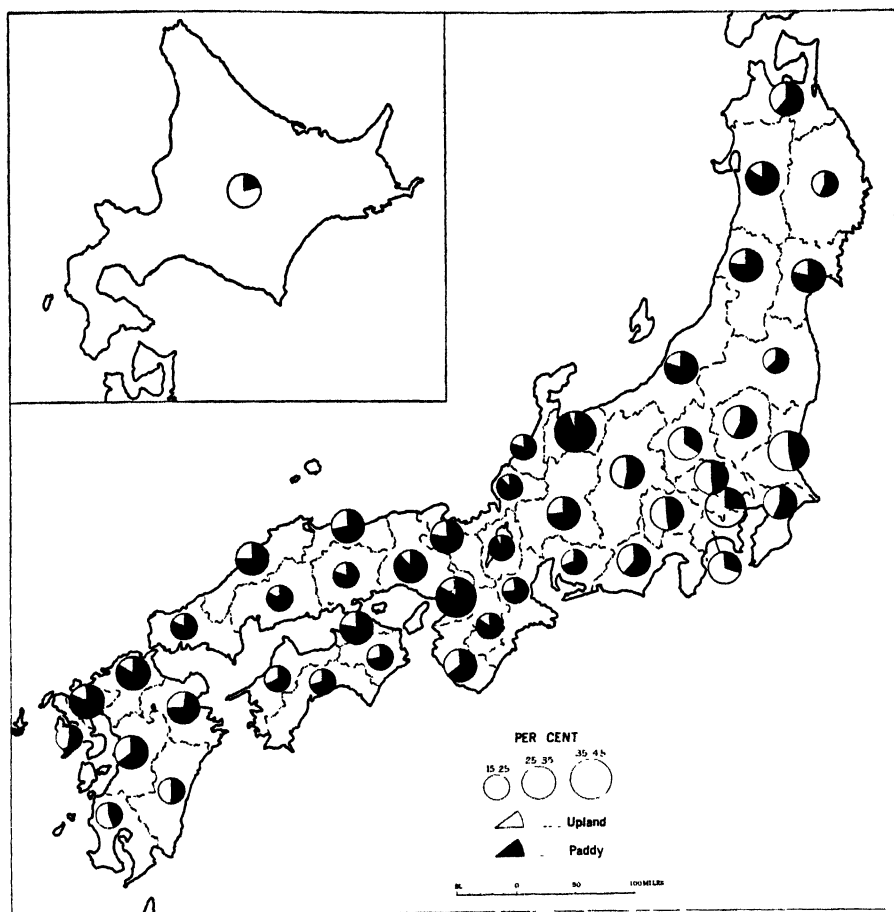


FIG. 5—Percentage of cultivated land purchased by the government to October, 1948. Compiled from (1) data on land purchases provided by Natural Resources Section, SCAP, and (2) data in "Civil Affairs Handbook on Japan," Section 7A, Agriculture, *Army Services Forces Manual M354-7A*, 1945.

Japan, however, change in ownership has not involved any important change in management; the individual operator, either owner or tenant, has always provided the management ability, and the landlord has contributed little or nothing. Moreover, it should be borne in mind that the land-reform program was not conceived primarily with a view to increased production and has involved no addition to the cultivated area. This problem is related to the second of the major elements in the Occupation's general plan, namely land reclamation.

RECLAMATION IN THE PREWAR YEARS

The basic problem of too little land and too many people has faced Japan for centuries, and the possibilities of reclaiming additional lands for

agriculture have been considered by many generations. However, under Allied influence, there has been a marked reactivation of government thinking on these matters.

Between 1877 and 1939 some 1,578,000 hectares⁸ of land was reclaimed and added to the agricultural area—an increase of about 35 per cent. That increase in cultivated area did not keep pace with population growth is indicated by the figures for the amount of cultivated land per capita: 0.13 hectare in 1877 and 0.083 hectare in 1939. It is significant also that three-quarters of the total area reclaimed in the 62-year period was brought under cultivation during the first 33 years. The marked slowing up of reclamation during the three decades before 1939, in spite of increased government activity, more liberal subsidies, and accelerated population growth, may be explained by the fact that the most readily reclaimable land was already in use by 1910. From 1910 to 1939 the average annual reclamation of land was only 12,000 hectares, and in not a few years the area of tilled land lost to other uses was greater than the area reclaimed. Official statistics show a net loss of 167,000 hectares between 1920 and 1930, and in 1942 the area of agricultural land was 368,000 hectares less than in 1930. Even in 1946, when the effects of the war demands for increased food and raw materials should have been evident, the area of agricultural land was 300,000 hectares less than in 1920. These figures are not wholly reliable, and since underreporting was characteristic of later years, it is believed that a part of the decrease in cultivated area is a paper decrease. The fact remains, however, that since 1934, Japan's cultivated area has increased very little, if at all. The large acquisitions for military uses resulted in a decrease of about 200,000 hectares between 1937 and 1945. Reclamation was unable to keep up with the demands for land for new homes, factories, and transport systems. This would seem to indicate that a ceiling has been reached in the expansion of the arable area under the present Japanese agricultural system.

POSTWAR RECLAMATION PLANS

The necessity of feeding a population augmented since the surrender by more than nine million has caused the Japanese government, under Allied pressure, to take a fresh look at the possibilities for increasing the area of agricultural land. The first of several ambitious government reclamation programs, covering the five-year period April 1, 1945, to March 31, 1950, had as its goal the reclaiming of 1,532,000 hectares. Several modifications

⁸ One hectare equals 2.471 acres. It is therefore practically the equivalent of the Japanese cho (2.45 acres).

and revisions of this plan have been proposed by the Japanese Land Development Bureau and noted in SCAP publications. The reportedly latest revision, made in November, 1947, outlines a 10-year program for the reclamation of 1,537,135 hectares (3,798,261 acres) of uncultivated land, including the land already reclaimed under the Occupation up to that time. If there should be no loss of present cultivated land, fulfillment of the 10-year program would increase the total cultivated area of Japan to 7,200,000 hectares (17,784,000 acres) by 1957, or by about one-fifth.

TABLE III—TEN-YEAR DEVELOPMENT PROGRAM OF THE JAPANESE GOVERNMENT*

TYPE OF LAND DEVELOPMENT	HECTARES	ACRES
Extension of cultivated area		
Change of forest or grassland to irrigated fields	42,643	105,371
Change of swamp or shallow water to irrigated fields	49,585	122,525
Change of forest or grassland to dry fields	1,444,907	3,570,365
Subtotal: New land	1,537,135	3,798,261
Improvement of present cultivated area ^a		
Irrigation improvements	1,280,000	3,162,880
Drainage improvements	1,320,000	3,261,720
Soil dressing	620,000	1,532,020
Consolidation of small holdings	470,000	1,161,370

*Estimated by Land Development Bureau, Ministry of Agriculture and Forestry, November, 1947.

^aNonadditive owing to duplication of practices.

It will be noted that the total area to be reclaimed under this newest program is only a little larger than that in the original five-year program, and most of the other features are similar. An overwhelming proportion of the reclaimable land has at present a cover of forest, scrub, or grass (Table III). Seventy-five per cent is forested land, but as this represents only 5 per cent of the present total forested area, the reclamation program should have no important effect on the supply of forest products. Only slightly more than 3 per cent is swamp or shallow water. Of the land to be reclaimed, about 35 per cent is judged to be in Hokkaido; the remainder is divided among the other three islands, the largest amount in the somewhat backward Tohoku region of northern Honshu. Significantly, only 6 per cent of the new agricultural land will be usable for irrigated rice fields; the remaining 94 per cent is upland and therefore suitable for nonirrigated crops only. In its initial stages this new land will be generally of lower quality than that already under cultivation. Even after several years of careful husbandry and adequate applications of fertilizer, its productivity will probably be lower than the average productivity of the present upland cropland. Moreover, a large part of the land to be reclaimed lies in the higher latitudes, where unfavorable climatic conditions limit agricultural output.

Individual reclaimable tracts range in size from less than a hectare to several thousand hectares. The smaller plots are usually interspersed with areas already farmed and at present are used for wood lots, composting, or windbreaks.

In April, 1948, the Planning Department of the Land Development Bureau issued a document containing estimates of the reclaimable lands of Japan based on surveys carried out between August, 1947, and March, 1948.⁹ It should be made clear that these figures do not form the basis for any present program or plan but rather represent a kind of "ultima Thule" of reclamation possibilities. The estimates are based on natural conditions only, and social and economic deterrents are not considered. Lands within the following limits are regarded as reclaimable:

1. Slope. Less than 15° to 20° .
2. Temperature. Average temperature from May to September more than 13° C. (55.4° F.) and more than 13° C. for more than 90 days.
3. Elevation. Within the temperature limits given above.
4. Water supply. Areas in which water can be made available in the future by proper construction works associated with reclamation.
5. Soil. Not to be especially poor.

The government estimate of April, 1948, indicates that a total of 5,012,760 cho is probably available for reclamation in projects of 50 cho or more. Land reclaimable in projects smaller than 50 cho had been estimated in earlier surveys at slightly more than 500,000 cho. The total recoverable land, therefore, as estimated by the Planning Department, would seem to be some 5,500,000 cho, or about $13\frac{1}{2}$ million acres, which is nearly equal to the area under cultivation at the present time. This is by far the most optimistic figure that has ever been offered for the possible expansion of the agricultural area of Japan.

Of the potential agricultural land estimated to be ultimately reclaimable in 14,787 projects of 50 cho or more, 36 per cent is considered to be in Hokkaido and 64 per cent in Old Japan. Again the Tohoku region of northern Honshu is estimated to have the largest amount, some 26 per cent of the total. The reclaimable land is analyzed in terms of terrain character and present use (Table IV), but no definitions are given for the descriptive terms used. We may conclude that nearly 90 per cent of the reclaimable land is upland and nonirrigable, most of it with relatively steep slopes; "plateau" land probably includes areas of diluvial upland and higher upland surfaces in the hill and mountain land.

⁹ "Brief Outline of Reclaimable Lands 21 April 1948," Planning Department, Land Development Bureau, Ministry of Agriculture and Forestry. (Typewritten.)

EVALUATION OF THE RECLAMATION PROGRAMS AND ESTIMATES

It is the belief of SCAP officials most closely associated with the agricultural work that the Japanese government's reclamation proposals and estimates are highly ambitious and unrealistic.¹⁰ My own field observations lead me to a similar conviction. Certainly this is true if the present system of agriculture, in which the overwhelming emphasis is on the growing of shallow-rooted annuals, especially cereals, is to be continued virtually unchanged. The amount of reclaimable land would be considerably greater if

TABLE IV—RECLAIMABLE AREA CLASSIFIED AS TO CHARACTER AND PRESENT USE*

<i>In cho</i>			
<i>Character</i>		<i>Use</i>	
Mountain	3,202,710	Forest	3,769,830
Plateau and hilly	1,197,830	Waste and grassland	1,129,940
Low	526,230	Swamp	41,690
Sand dune	16,720	Sand dune	2,030
Lake and sea surface	69,270	Lake and sea surface	69,270
Total	5,012,760	Total	5,012,760

*"Brief Outline of Reclaimable Lands" (*op cit*).

certain fundamental changes were made in the agriculture; for example, a greater use of grazing animals, pasturelands, hay and forage crops, and bush and tree crops. Nevertheless, Japan's ability to reclaim 1,500,000 hectares even by 1960 is highly problematical.

It is possible that SCAP's prodding of Japanese government officials in its eagerness to improve the food situation by getting a reclamation program under way is one reason for the formulation of a hastily conceived paper plan. A desire on the part of the Planning Department to please the SCAP officials may also have been a factor. Moreover, the Land Development Bureau (since March, 1949, the Agricultural Land Bureau) is staffed by men not trained in agricultural science, so that their planning programs and estimates have many impracticable features. No accurate information exists concerning the areas and locations of the different types of land suitable for reclamation, and no attempt was made to obtain this information by field surveys before the programs and estimates were prepared. One gathers that the army topographic maps, scale 1 : 50,000, were the principal source of information. Field inspection by SCAP officials has shown the desirability of excluding from the reclamation program certain kinds of lands included in the government's estimates of reclaimable areas, more especially those in high altitudes, and marshes, peat bogs, and lakes.

¹⁰ "Outlook for Japanese Agriculture," *Natural Resources Section Preliminary Study No. 25*, GHQ, SCAP, Tokyo, 1948, p. 6.

Furthermore, in the first years of the program the annual goals were far from being attained. The land actually reclaimed in the fiscal year 1945 was only 55 per cent of the goal set, and reclamation at that time was proceeding on the most readily accessible land, much of it military land that had been out of crop production for only a few years. The greater and vastly more difficult part of the program remains to be carried out, and it seems likely that the future rate of reclamation will be even slower. Between July 1, 1945, and December 31, 1947, about 284,000 hectares were acquired for reclamation, an average rate of more than 9000 hectares a month. An examination of this average reveals a gradual decrease in the monthly rate from an average of 14,000 hectares in the period July 1, 1945, to June 30, 1946, to an average of 6000 hectares in the period July 31 to December 31, 1947. In the latter period the rate of reclamation fell from 11,000 hectares in July to 3000 hectares in December.¹¹ As of July 1, 1949, a total of only 356,000 hectares had been purchased for reclamation. A recent SCAP publication ventures the opinion that it may be possible to attain 75 per cent of the reclamation goal by 1960. This still seems an optimistic figure. There are certain to be losses of agricultural land resulting both from physical destruction and from diversion to other economic uses, so that the net gain will be materially reduced. In recent years losses due to physical causes alone have amounted to about 22,000 hectares annually. But even if the reclamation program looking to the addition of 1,537,000 hectares to the agricultural area should be completed by 1960, it is estimated that for a population of 92 million there would still be a food deficit of 20-25 per cent.¹² If Japan's population continues to multiply at the rate it did before and after the war, it seems impossible that the country can ever become self-sufficient in food. The realistic question is how far toward self-sufficiency reclamation and agricultural-improvement programs can carry the country and how rapidly these programs can be accomplished.

As a result of field surveys, SCAP officials discovered that the reclamation program was purchasing many lands unsuited to agriculture. Therefore, on September 1, 1948, instructions were issued to the prefectural governors by the Ministry of Agriculture and Forestry, with the approval of the Natural Resources Section of SCAP, to the effect that the target quotas set for land purchase in 1948 should be disregarded. In the future new land can be purchased only after adequate field surveys have shown that it is more suitable for agriculture than for other uses. These surveys are to be con-

¹¹ *Ibid.*

¹² *Ibid.*

ducted by committees of the *gun*¹³ offices, the committees to be composed of local experts with knowledge of agriculture, forestry, and the livestock industries within a restricted political unit.

LAND RECLAMATION AND THE FOOD SUPPLY OF JAPAN

It has been suggested previously in this paper that one of the handicaps to any reclamation program in Japan arises out of the nature of present-day Japanese agriculture. The overwhelming importance of paddy rice places a disproportionate value on lowlands, which can easily be flooded, and minimizes the value of upland or dry sites, the only extensive areas capable of being reclaimed for agriculture. Before going to Japan, I had been led to believe that every fragment of level or near-level land was intensively used in the production of crops, particularly food crops, for a dense and rapidly increasing population. Much to my surprise, on my first field excursion across the Kanto Plain, which supports the largest population cluster in Japan, including the metropolises of Tokyo and Yokohama, I observed relatively large upland areas planted in forest or grown up in shrub and wild grasses. I saw the same thing in other parts of Japan. Inquiry as to why such land was not under cultivation received the same general answer, "Because it is unsuited to rice growing."

There is no doubt that the reclamation programs of the Japanese would have a better chance of success if upland sites were more intensively utilized. Less dependence on rice as a staple food and greater use of food crops not requiring irrigation, especially tree and bush crops, and a greater consumption of foods from grazing animals would also make for success. I am not unmindful of the great difficulties involved in changing the centuries-old eating habits and agricultural methods of the Japanese. The stubbornness with which a people resists change is a well-known fact, but in the face of the dilemma confronting Japan even modifying the mores of a nation is worth attempting. A brief statement follows concerning possible modifications or improvements in Japanese agriculture and in the utilization of upland sites.

Consolidation of Small Holdings. A common feature of Japanese agriculture that has an injurious effect on production efficiency is the extreme subdivision of the farm units, their irregular shapes, and the widespread dispersion of the individual plots and fields. The several noncontiguous plots or fields making up a Japanese farm range in size from a few square yards to more than half an acre. Many times these plots are as much as a mile apart,

¹³ A political subdivision intermediate between the prefecture and the village.

and not infrequently double that. The Ministry of Agriculture and Forestry estimates that about 470,000 hectares (1,161,370 acres) could be improved by consolidation, with a resulting possible increase in yield of about 4 per cent. However, this improvement probably could not be accomplished in less than 50 years, so that the total effect on food production would be small. Also, the scatteredness of a farm is not entirely disadvantageous; for a certain amount of dispersion spreads the risks against disaster and ensures a more equitable distribution of the best land.

Food and Feed Crops. In the United States it is the general practice to harvest only one crop annually from a field and then allow the soil to remain fallow until the next season's planting. In Japan, on the other hand, numerous fields are made to produce two harvests a year, or occasionally even more. Only in Hokkaido and northern Honshu, and at higher elevations farther south, does climate prevent fall planting. At the present time about a third of the nation's cultivated land bears more than one crop annually; for subtropical Japan the figure obviously is higher. Nevertheless, it seems probable that a considerably larger number of the upland fields could be made to bear a second crop. Of course, one of the major problems would be how to maintain and even increase the fertility of the originally infertile residual upland soils under such intensive cropping. Before the war large amounts of commercial fertilizer had to be imported. But it is much cheaper and requires less labor and ship tonnage to import fertilizers for additional crop acreage than to import the foodstuffs these fertilizers would produce.

If the same careful husbandry now lavished on the paddy lands were applied to upland fields, production would be considerably increased. The common practice in hillside farming of planting row crops of annuals parallel to the slope needs correction. Already the injurious effects of soil erosion are obvious in many upland farming areas. A more careful terracing of fields on the steeper slopes would greatly reduce erosion, but this is an arduous and expensive improvement. Intercropping rows of soil-retaining crops with others is simpler. An expansion of the animal industries would permit a greater use of slopes for tame pasture, hay and forage crops, and plants for green manure—forms of use that reduce slope wash.

Worthy of consideration, also, is the possible expansion of the upland winter-crop area in the paddy lands. The Natural Resources Section of SCAP estimates that some 44 per cent of the paddy area south of about latitude 37° is left unplanted in the fall after the harvest of the single rice crop. A part of this land is in the interior highlands, where the growing

season is too short for winter wheat and barley. Elsewhere lack of sufficient fertilizer has been a deterrent. A more widespread cause, however, is the inability to drain many rice fields adequately. The Ministry of Agriculture and Forestry estimates that within the part of Japan where double cropping is climatically practicable about 700,000 hectares (1,729,700 acres) of wet paddy land could be drained and thus made suitable for fall planting of unirrigated crops. To provide improved drainage facilities has been a part of the general Japanese land-reclamation program that has been accelerated under the Allied Occupation. However, as a result of shortages of materials and a variety of other causes, not much progress has been made, and the problem of draining the paddy lands for winter crops remains one of the important reclamation opportunities for an expansion of the area in food crops.

SCAP officials believe that the introduction of wholly new crops holds little promise as a means of increasing the food supply. More is to be hoped for from the introduction of new varieties with higher productivity or greater resistance to disease and the more widespread use of certain crops giving high per-acre yields. Among the latter is maize or Indian corn, which has found great favor in parts of subtropical and tropical Southeast Asia. In Java, for example, it is second only to rice in importance, and in some of the hilly provinces of Southwest China maize occupies as much as 14 per cent of the cultivated area. In Japan, on the other hand, it has been neglected, being grown on only about 1 per cent of the area in crops. Several characteristics of maize seem to make it a particularly satisfactory crop for the uplands of subtropical Japan. Maize thrives better and yields more than other grains on steep slopes and shallow soils. And although it lends itself well to machine culture on level lowlands, it may also be profitably planted, cultivated, and harvested by hand on steep slopes. Its yields of both grain and fodder are high, higher than those of any of the other cereals. Its high yields in forage or fodder make it a desirable adjunct of any expansion of the animal industries. It is not unthinkable, also, that the Japanese, like many other Asiatic peoples, could learn to incorporate corn more widely into their diet.

Some improved high-yielding varieties of grain sorghums might also with profit be more widely cultivated in Japan. Kaoliang is at present grown, but its yields in grain are not equal to those of certain improved varieties of milo, kafir, and their hybrids. Replacement of kaoliang, and perhaps of some of the millet, by these high-yielding varieties and expansion in the total acreage of such crops might well be considered part of any program for agricultural improvement in Japan.

Bush and Tree Crops. Any plans for an expansion of the crop area in the

hill lands of Japan should not neglect the suitability and advantages of arboriculture. Trees with their relatively deep and extensive root systems can thrive in areas of poor and thin surface soils where annuals are less at home. Bushes and trees need less extensive terracing on slopes than clean-cultivated vegetables and cereals, for their roots tend to anchor the soil and thus reduce erosion. Grasses and forage crops planted between orchard trees will reduce erosion still further. Slopes already seriously eroded of their topsoil are satisfactory for orchards if sufficient subsoil remains. Moreover, fruit and nut crops require an unusual amount of hand labor, so that in the pruning, spraying, harvesting, packing, and shipping good use could be made of the abundant and painstaking rural labor supply. And an increase in the amount of fruit and nuts in the Japanese diet would be good for the health of the nation.

Careful consideration should be given to the possible expansion of two relatively important bush crops—tea and mulberry. Tea is an ideal slope crop, since it requires little terracing and when planted in rows at right angles to the slope is an excellent preventive of erosion. It is not unusual to see tea gardens occupying hillside fields where the slope is 20° – 30° . The problem that looms large in any expansion of the tea area is Japan's ability to compete for foreign markets with the regions of tropical South Asia, where labor is cheaper and the yield of leaf per unit area is larger.

Mulberry is the exclusive food of silkworms, and as such it is the basis for the most important animal industry in Japan. Since it does not require irrigation and is soil-tolerant, it is largely a crop of the slope lands. Mulberry is grown throughout Japan south of about the 39th parallel, and before the war only two crops, rice and wheat, exceeded it in acreage. First the depression of the thirties, and later the competition of synthetic fibers and the war, greatly injured the raw-silk industry of Japan, so that the mulberry acreage dropped from a peak of 714,000 cho in 1930 to 186,000 cho in 1946. As late as 1931, 40 per cent of the Japanese farm families derived their chief cash income from the sale of silkworm cocoons. The serious decline of raw silk has been a major disaster to the country's economy.

To what degree the raw-silk industry can be revived in Japan depends largely on the extent to which the foreign markets can be recaptured. Most textile men seem to feel that the outlook is not bright. The American market, which originally took about 90 per cent of Japan's silk output, has been increasingly monopolized by synthetic fibers, which will be difficult to displace. It is worthy of note that both Japanese and SCAP officials are not too optimistic about a large-scale revival of raw-silk markets abroad: the five-year plan, beginning in 1947, for expanding silk production calls for an increase in the mulberry acreage to 267,000 hectares in 1951—only about

80,000 hectares more than in 1946. But in spite of a not too bright outlook, the situation certainly warrants a most careful study with a view to presenting Japanese raw silk and silk fabrics to Western markets in the most favorable light possible. In so many ways the raw-silk industry, utilizing a large amount of hand labor and depending on a bush crop suited to slope sites, is ideal for Japan. Moreover, the export of raw silk is the equivalent of exporting human labor, one resource that Japan has in abundance. It is difficult to see at present just what can be substituted for raw silk as a source of cash income for a large percentage of Japanese farmers.

Animal Industries. Oriental agriculture has largely disregarded pastoral resources. Japan, with an abundance of hill and mountain land, most of which is unfit for ordinary cultivation, is conspicuously undeveloped in animal industries. The almost complete absence of flocks and herds strikes one as anomalous; for the grazing of cattle and sheep is a specialty in many other middle-latitude regions of the world that have a rugged terrain. Less than 30 per cent of the Japanese farm families own cattle, and 80 per cent of these have only a single head. More than 90 per cent of the cattle on the farms are draft animals. Census statistics of livestock in Japan in 1947 were as follows: 159,000 dairy cattle, 1,830,000 draft cattle, 1,054,000 horses, 100,000 hogs, 239,000 sheep, 278,000 goats, 2,000,000 rabbits, 18,000,000 poultry. The per capita number of grazing-animal units is only one-fifteenth of that in the United States.

Certain physical, economic, and social factors impose obstacles to a greater use of pastoral resources in Japan. The long, hot, humid summers characteristic of much of the country affect unfavorably both animals and most forage crops. Greatest of the physical handicaps, however, is the general lack of good natural pastureland. The native wild grasses of much of the hill land are coarse, harsh, and unnutritious, and also difficult to eradicate; and the subtropical climate and the associated poor acid soils make difficult the successful propagation of many of the well-known tame grasses. Little research has been done on the production capabilities of soils and native grasses for forage crops. It is recognized, however, that land exists which could be used for the development of a livestock industry. The Ministry of Agriculture and Forestry estimates that more than seven million acres bearing a cover of wild grasses, shrub, and thin forest could be used for grazing without any serious encroachment on the profitable forest area. Such a use would not only increase the nation's food supply but would also be a guarantee against erosion and greatly increase the supply of much-needed animal manures. It seems highly appropriate that in conjunction with the general land-reclamation program a careful survey be made of the po-

tential grazing and forage-crop land and plans be formulated for its more profitable use. It must be emphasized, however, that milk and beef animals require feeds other than pasture, and any large increase in grazing animals must therefore be accompanied by an increase in the present deficient supply of feed concentrates and winter fodder.

In addition to the physical handicaps that discourage the animal industries, there are those of a social and economic nature. The farm people lack capital for the purchase of livestock and equipment for their keep, so that government aid would probably be necessary in getting a program started. Commercial dairying is retarded by the small domestic market for milk and milk products, for which the Japanese have never acquired a taste. Moreover, the poverty of the great mass of the population greatly restricts the market for both meat and dairy products.

Without doubt numerous handicaps and discouragements do exist to the greater use of the uplands for pastoral purposes and as supply sources for feed concentrates and fodder. Nevertheless, the desperate situation in which Japan finds itself justifies a serious attempt at as complete a utilization of the meager resource base as possible, even though this should involve the gradual changing of some of the basic eating habits of the people.

Stranger even than the paucity of grazing animals raised to supply food is the much greater scarcity of scavenger animals such as the hog and the modest number of farmyard poultry. Such prolific animals, able to thrive, in part at least, on household waste, seem particularly suited to Japan. The unusual emphasis on swine and poultry in China, where the hog population is probably equal to that in the United States, strengthens the argument for a greatly increased number in Japan. Chinese agriculture and Japanese agriculture have so many features in common that animals which fit well into the Chinese rural economy would expectably be a satisfactory adjunct of Japanese agriculture as well.

I am well aware that I may be accused by many Japanese friends of having engaged in unrealistic speculation. The remarkable accomplishments of the Japanese people in agriculture and forestry have given them high rank among the earth's husbandmen. It may appear presumptuous, therefore, that a foreigner far removed from the scene of operations should be so bold as to make suggestions. My only excuse for this presumptuousness is a belief that occasionally an outsider, adjusted to another type of material civilization, may see a situation in a somewhat different light from one who has lived so long in his native atmosphere that perceptions have been dulled to the possibilities of change.

THE "COLOURED" COMMUNITY IN THE UNION OF SOUTH AFRICA

KEITH BUCHANAN AND N. HURWITZ

THREE centuries of miscegenation between aboriginal Bantu and Khoisan¹ peoples, immigrant Europeans, and European-introduced slaves of Malay and Negro stock have evolved in the Union of South Africa the distinct ethnic group known as the "Coloureds." This hybrid community is a critical element in the complex structure of the Union. Biologically, it has received contributions from all the peoples of South Africa; culturally, its affinities are with the dominant European group; economically, it shares the poverty and lack of opportunity of the great mass of the non-Europeans; politically and economically, it occupied a relatively favored position in the past, at least in the Cape, but today it finds itself bearing the first brunt of the racist and segregationist policy of the new South African Nationalist government.²

THE ORIGINS OF THE CAPE COLOURED GROUP

Biologically, the Cape Coloured community is of outstanding interest because it offers an example of a racial or ethnic group in the process of evolution. Mixing between Europeans and other racial groups in South Africa dates from the second half of the seventeenth century; the first non-European groups involved were West African slaves and slaves of Indian and Malay origin imported by the East India Company. The extent of race crossing during the early years of the Cape settlement may be judged from the report that three-quarters of the children born to slave mothers during the first 20 years of settlement had European fathers.³

¹ On the Khoisan peoples see Isaac Schapera: *The Khoisan Peoples of South Africa: Bushmen and Hottentots*, London, 1930.

² On the history of the Coloureds see J. S. Marais: *The Cape Coloured People, 1652-1937*, London, New York, Toronto, 1939; C. Ziervogel: *Brown South Africa*, Cape Town, n.d.; W. M. Macmillan: *The Cape Colour Question*, London, 1927; and the chapter by Professor Macmillan on "The Problem of the Coloured People, 1792-1842," in "The Cambridge History of the British Empire," Vol. 8, Cambridge and New York, 1936, pp. 274-294 (Chap. 12).

³ François Valentyn (*Beschryving van oud en nieuw Oost-Indien*, Vol. 5, 1726, p. 38, quoted in *Official Year Book Union of South Africa*, No. 23, 1946, Chap. 25 [preprint, 1947], p. 13) gives an impressive picture of the diversity of peoples in the early-eighteenth-century Cape: "Netherlanders, English, French, High Germans from various parts, Savoyards, Italians, Hungarians, Malays, men of Malabar, Cingalese, Javanese, men of Macassar, of Bengal, of Amboyna, of Bambana, of Bougena, of China, of Madagascar, of Angola, inhabitants of Guinea, and of the Salt Islands . . ."

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MR. HURWITZ is lecturer in economics at the University of Natal.

In the early years of the settlement of the Cape by the servants of the Dutch East India Company religious considerations helped to rationalize the European's attitude of superiority, but as conversion to Christianity increased, discrimination became increasingly based on skin color, and it was no longer possible for half-caste children to enter the dominant group merely by adopting Christianity. Nevertheless, owing to the link with the European way of life through his mother, the half-caste did receive a certain amount of preferential treatment and became the craftsman, the foreman of the unskilled laborers, and the trusted servant. Further, the belief in the superiority of European blood inclined the European to feel that the half-caste must be superior to those unprivileged by such admixture, and the Cape Coloured came early to occupy an intermediate position between the Europeans and native peoples.⁴ To this original European-slave stock have been added mixed populations derived from European-Hottentot⁵ and slave-Hottentot crossings, from crossings between Bantu and Coloured elements, and a small proportion of mixed blood of partly Indian origin. Today this mixed group, "Cape Coloureds" in the strict sense of the term, constitutes some three-quarters of the total number classed by the census as "Mixed and other Coloured"; one-twentieth consists of Cape Malays,⁶ and the remaining one-fifth of so-called "aboriginal Coloured races"—Bushman, Hottentot, Griqua, Koranna, and Namaqua.

POPULATION GROWTH AND NUMERICAL RELATIONSHIP TO OTHER COMMUNITIES

The growth of the Coloured population and its relation to other groups in the Union are summarized in Table I. It will be seen that although the Coloured community has doubled in the last 40 years, its numerical relationship to the other communities in the Union has remained relatively stable.

Eighty-eight per cent of the Coloureds, however, dwell in Cape Province, and here the picture is somewhat different. The relevant statistics are given in Table II. In the Cape the Coloured group has shown a strong relative as well as absolute increase in the last 40 years, and today it constitutes one-fifth of the total population of the province.

The Coloureds are not evenly distributed throughout Cape Province. In the eastern districts they make up less than one-third of the total population;

⁴ Based on H. Sonnabend and Cyril Sofer: *South Africa's Stepchildren, South African Affairs Pamphlets No. 16 (3rd Ser.)*, Society of the Friends of Africa, Johannesburg, 1948, pp. 16-17.

⁵ Owing to their wildness and elusiveness, the Bushmen are supposed to have contributed relatively little to the evolution of the Cape Coloureds.

⁶ On the Cape Malays, a relatively homogeneous Mohammedan group of Asiatic slave origin who are officially classed as "Coloureds," see I. D. du Plessis: *The Cape Malays, Cape Town, 1944*.

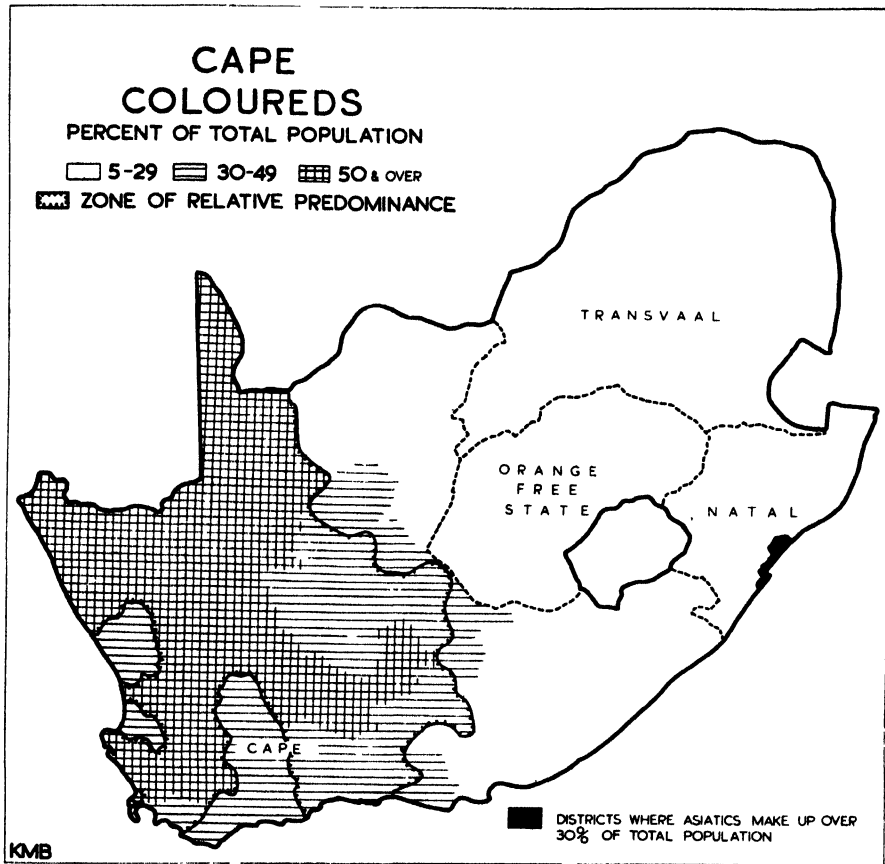


FIG. 1

TABLE I—POPULATION OF THE UNION, 1904-1946

YEAR	EUROPEANS	ASIATICS	NATIVES	COLOUREDS	COLOUREDS AS EUROPEANS	% OF TOTAL
1904	1,116,806	122,734	3,491,056	445,228	39.9	8.6
1911	1,276,242	152,203	4,019,006	525,943	41.2	8.8
1921	1,519,488	165,731	4,697,813	545,548	35.9	7.9
1936	2,003,857	219,691	6,506,689	769,661	38.3	8.0
1946	2,335,460	282,539	7,735,809	905,050	38.3	8.1

Source: *Official Year Book Union of South Africa*, No. 23, 1946, Chap. 25 (preprint, 1947), p. 3. The figures for 1946 are preliminary.

TABLE II—POPULATION OF CAPE PROVINCE, 1904-1946

YEAR	EUROPEANS	ASIATICS	NATIVES	COLOUREDS	COLOUREDS AS EUROPEANS	% OF TOTAL
1904	579,741	10,242	1,424,787	395,034	69.9	16.8
1911	582,377	7,664	1,519,939	454,985	78.1	17.7
1921	650,609	7,696	1,640,162	484,252	74.4	17.4
1936	791,574	10,508	2,045,570	682,248	86.2	19.3
1946	859,611	16,901	2,327,099	813,190	94.6	20.2

Source: *Official Year Book Union of South Africa*, No. 23, 1946, Chap. 25, p. 3. The figures for 1946 are preliminary.

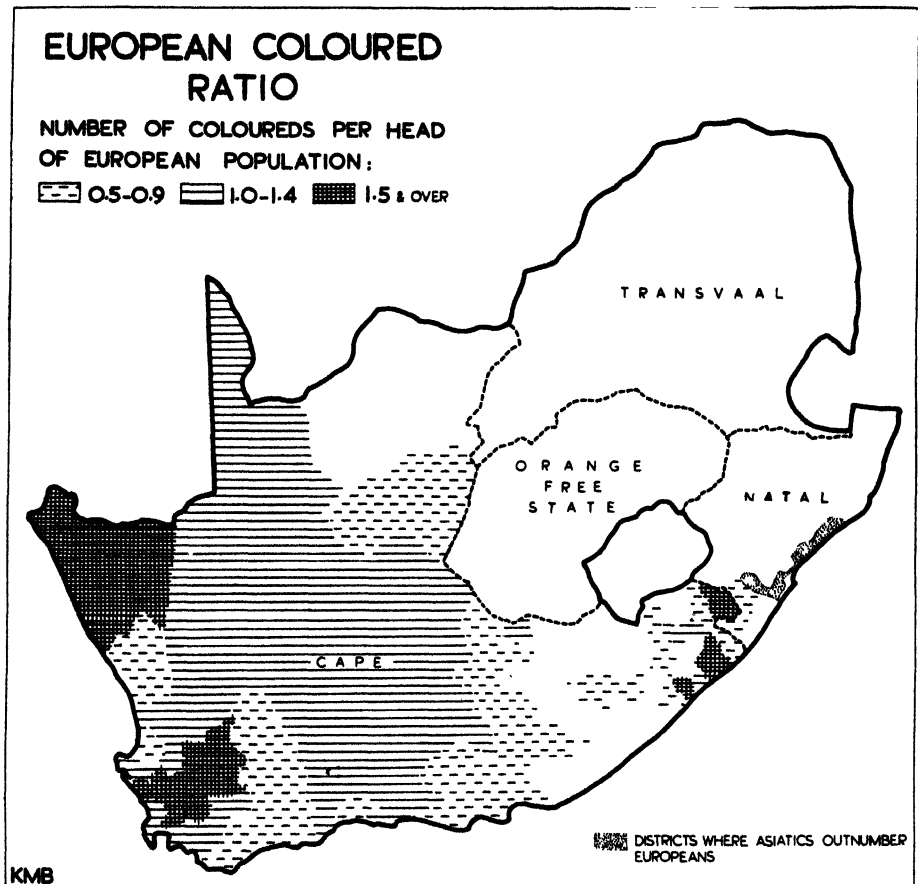


FIG. 2

in the west they outnumber all other ethnic groups combined. This zone of absolute preponderance reaches eastward over the interior plateau to the vicinity of De Aar (Fig. 1), and it is fringed by a broad belt extending crescentwise from Hay in the north to Mossel Bay in the south within which the Coloured community is more numerous than any other single ethnic group.

But the politically important ratio is that between the Europeans and the Coloureds who aspire to equality with them. Again there are contrasts between the national and provincial levels. In the Union, in 1946, there were 38 Coloureds per 100 Europeans; in 1904 the ratio had been 40:100. In the Cape, on the other hand, as a result of rapid increase in the number of Cape Coloureds and of a certain amount of European emigration to the other provinces, the Coloured position has been progressively strengthened: in 1904 the Coloured-European ratio was 70:100; by 1946 it was 95:100.

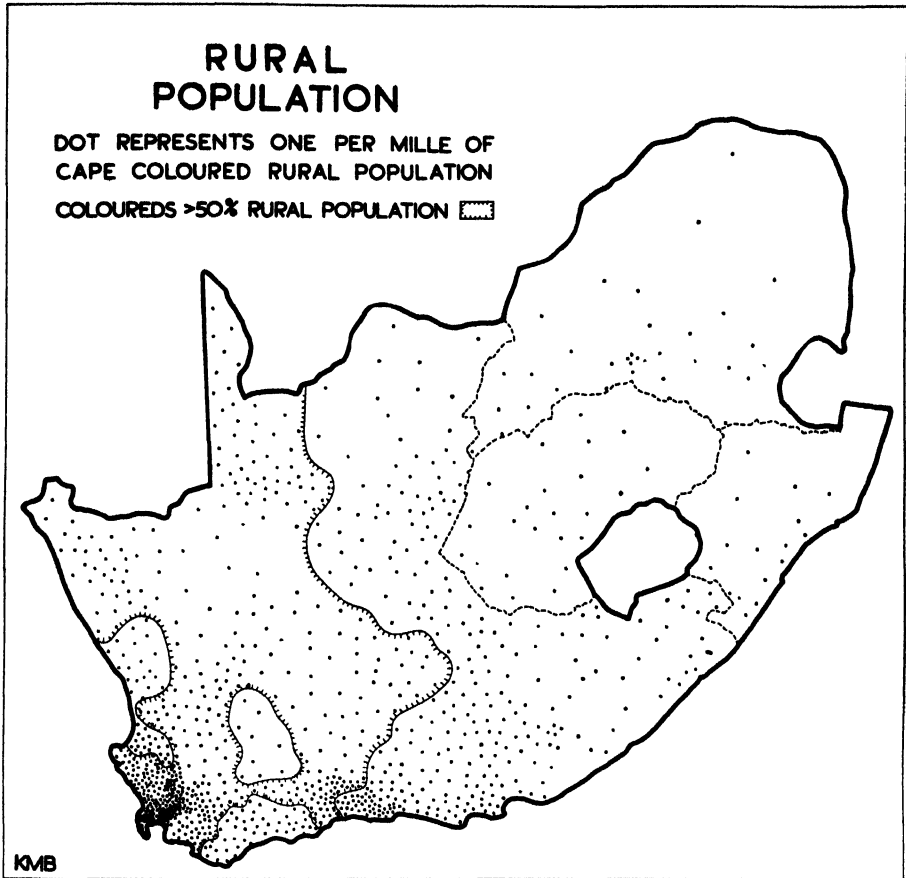


FIG. 3

In 1936 the Coloureds outnumbered the Europeans over the larger part of the interior plateau (Fig. 2) and reached their greatest numerical superiority (more than 150:100) in the thinly populated northwestern Cape, in the closely settled intensive farming zone lying inland from Cape Town, and in scattered districts in the dominantly native Transkeian Territories. A knowledge of the progressive deterioration in the numerical relationship of the European group to the Coloureds is basic to an understanding of present-day policies in the Union.

GEOGRAPHICAL DISTRIBUTION OF THE COLOURED

The distribution of the Coloured population among the four provinces is given in Table III. As would be expected on historical grounds, the Coloured group attains its greatest importance in Cape Province, and here, within some 200 miles of Cape Town, is one-half of the entire Coloured

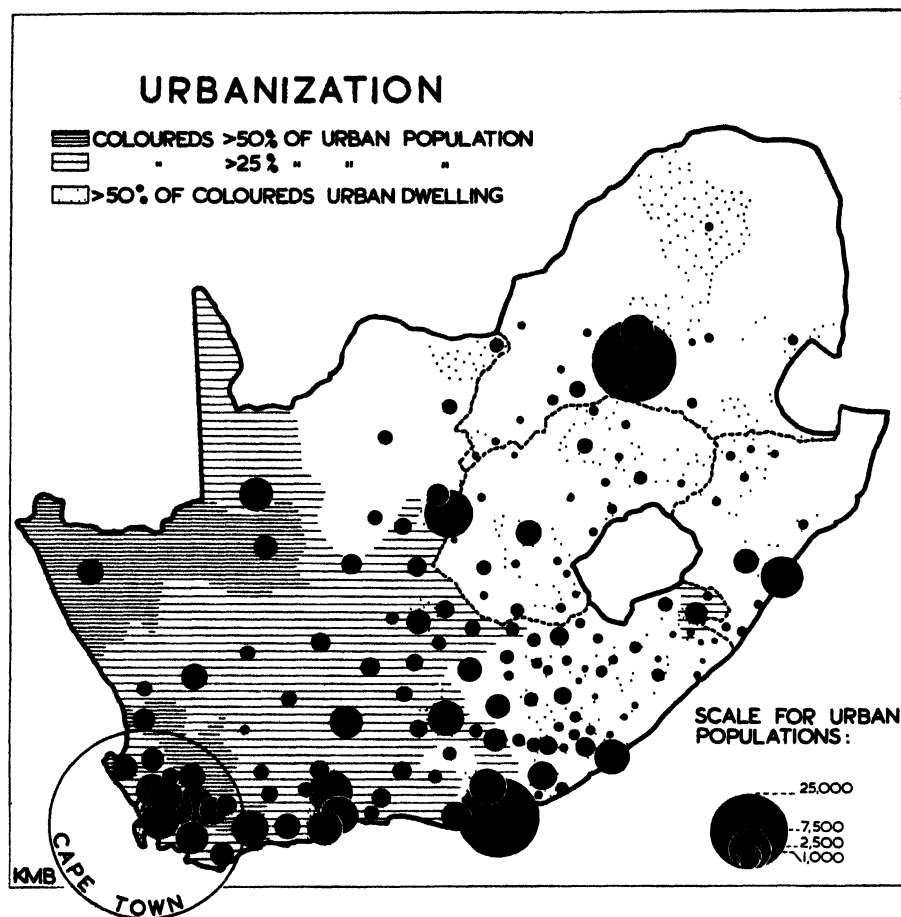


FIG. 4

population of the Union—Cape Town and its vicinity alone account for one-quarter. In the Cape, where 48 per cent of the Coloured population is rural, the distribution pattern is strongly influenced by the predominant type of farming: the extensive pastoral economy of the interior plateau supports only a low to medium density; the major nuclei of Coloured rural population are in the intensive fruit-growing districts in the extreme south-west (Fig. 3). In the Transvaal the main concentration is in the south, especially in the Witwatersrand area; here some two-thirds of the province's

TABLE III—PROVINCIAL DISTRIBUTION OF THE COLOURED POPULATION, 1936

	CAPE	NATAL	TRANSVAAL	ORANGE FREE STATE
Total	682,248	18,629	50,841	17,943
% of Union	88.64	2.42	6.61	2.33

Source: U.G. No. 12, 1942 (see footnote 7, below), p. xxiv.

Coloureds are to be found, and of these one-third are Cape-born. The same concentration in the south, i.e. in proximity to the Cape, exists in Natal; the districts of the southern midlands and the south coast contain three-quarters of the provincial total.

As a whole the Coloured group is less heavily urbanized than the European and Asiatic groups; in detail there are significant differences between the provinces (Fig. 4) and between the various elements of the Coloured community. In the Cape and the Orange Free State the proportion occupied in agriculture is high, and only one-half of the Coloureds are urban-dwelling; in Natal and the Transvaal the Coloured population has tended to gravitate toward nonagricultural occupations and shows a high degree of urbanization—67 per cent in Natal, 74 per cent in the Transvaal. Of the ethnic groups that make up the Coloured community, the "aboriginal Coloured races" (Bushmen, Hottentots, Korannas, etc.) tend to avoid the towns (only 33 per cent are urban-dwelling), whereas the Cape Malay is essentially urban (96 per cent, chiefly in Cape Town); the Cape Coloured (in the strict sense) occupies an intermediate position (58 per cent).

In contrast with the Asiatic group, whose diffusion through South Africa has been restricted by legislation, there has been a certain amount of Coloured emigration from Cape Province to the other provinces of the Union. In 1936, Cape-born Coloureds made up almost one-twentieth of the Coloured population of Natal and the Orange Free State, and almost one-third of that of the Transvaal. Of the Coloureds of Cape Province, 99.3 per cent were Cape-born.

ELEMENTS OF DIVERSITY IN THE COLOURED COMMUNITY

The fourfold division of the Union's population into European, Native (or Bantu), Asiatic, and Coloured is widely accepted in everyday life, and, though geographers and politicians may dispute the precise limits of the groups, of their individuality there can be no doubt. Each group, however, shows a certain measure of internal diversity, arising from contrasts in racial make-up, language, or religion, and nowhere is this more evident than in the Coloured community.

Table IV indicates the relative importance of the diverse racial or ethnic elements comprised in the census category "Coloured." The outstanding feature is the contrast between Cape Province, where the Coloured population is predominantly Cape Coloured, and the Orange Free State and Natal. In the Orange Free State Cape Coloureds make up only 43 per cent of the total Coloured group; the "aboriginal Coloured races," notably Griqua and

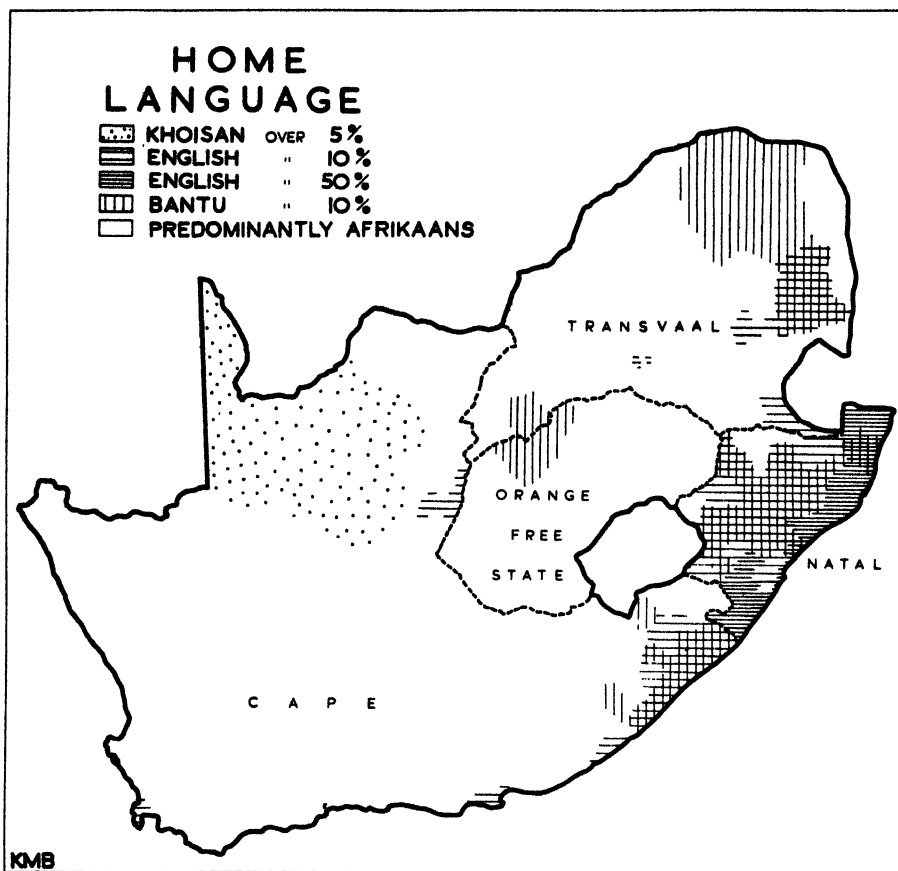


FIG. 5

TABLE IV—ETHNIC COMPOSITION OF THE COLOURED POPULATION, 1936

ETHNIC GROUP	CAPE	NATAL	TRANSVAAL	O.F.S.	UNION
	%	%	%	%	%
Cape Coloured	76.83	55.27	72.06	43.01	75.21
Cape Malay	4.55	2.34	4.75	1.34	4.43
Bushman and Hottentot	12.59	1.38	7.40	17.34	12.10
Other aboriginal					
Coloured races	4.21	4.88	8.75	32.05	5.17
Other mixed	1.82	36.13	7.04	6.26	3.09

Source: U.G. No. 12, 1942, p. xxv.

TABLE V—HOME LANGUAGES OF THE COLOURED, 1936

LANGUAGE	CAPE	NATAL	TRANSVAAL	O.F.S.	UNION	UNION EUROPEANS
	%	%	%	%	%	%
English	6.0	61.3	11.6	1.0	7.6	39.1
Afrikaans	92.0	23.5	81.4	94.8	89.7	55.9
English and Afrikaans	1.0	2.2	1.8	0.5	1.0	2.5
Native languages	0.4	7.1	2.9	2.3	0.7	—
Khoisan	0.5	—	—	—	0.5	—
Others	0.1	5.9	2.3	1.4	0.5	2.5

Source: U.G. No. 44, 1938, Tables 9 and 15.

Hottentot, make up one-half. In Natal slightly more than one-half are Cape Coloureds; one-twelfth are of St. Helena origin, and the remainder are of part Asiatic origin. Both the Asiatics and the St. Helena group are descended from laborers imported to work on the sugar plantations of the coast belt.

The Coloured community has taken over the two major European languages spoken in the Union, and only an insignificant minority speak either the Khoisan or the Bantu languages. The linguistic situation in 1936 is summarized in Table V. The pattern closely follows that of the Europeans, and, except in Natal, Afrikaans is the traditional home language of the Coloured group. This is due to the dominance of Afrikaans in the European community and to the fact that a large proportion of the Coloureds are engaged as laborers on Afrikaans farms, especially in the Cape and the Orange Free State. English is spoken widely among the scattered Coloured groups of eastern Natal (Fig. 5) and in the adjoining districts of the Transkei; Bantu is most important in interior Natal, most of the Transkei, and the eastern Transvaal. Only one two-hundredth of the Coloureds speak Bushman or Hottentot, and these are concentrated chiefly in the semidesert northern Cape; since one-eighth of the Union's Coloured population are classed racially as Bushmen or Hottentots, it is evident that even among these primitive groups the languages of the dominant European group have been widely adopted.

It has been observed that among the Coloureds "religious denominations are apt to have a restrictive effect . . . on the development of wider community life embracing the members of different denominations, especially since the schools attended . . . are, for the greater part, denominational,"⁷ and certainly the group shows a high degree of religious fragmentation. Some fifty religious groups are distinguished in the census, and, in contrast with the European and Asiatic communities, religious boundaries frequently cut across linguistic and other lines of cultural cleavage. Comparison of the European and Coloured communities is instructive. Out of a total European

⁷ Report of Commission of Inquiry Regarding Cape Coloured Population of the Union, Pretoria, 1937, paragraph 51. This publication and volumes of the Sixth Census of the Union of South Africa, 1936, are referred to in the footnotes (to text and tables) by the serial number and date: U.S. No. 54, 1937: Report of Commission of Inquiry . . .

Sixth Census

U.G. No. 11, 1942: Vol. 7, Occupations and Industries.
 U.G. No. 12, 1942: Vol. 9, Natives and Other Non-European Races.
 U.G. No. 21, 1938: Vol. 1, Population.
 U.G. No. 24, 1942: Vol. 5, Birthplaces, Period of Residence and Nationality.

U.G. No. 28, 1938: Vol. 2, Ages.
 U.G. No. 28, 1941: Vol. 6, Religions.
 U.G. No. 33, 1939: Vol. 8, Dwellings.
 U.G. No. 44, 1938: Vol. 4, Languages.
 U.G. No. 49, 1939: Vol. 11, South African Life Tables.

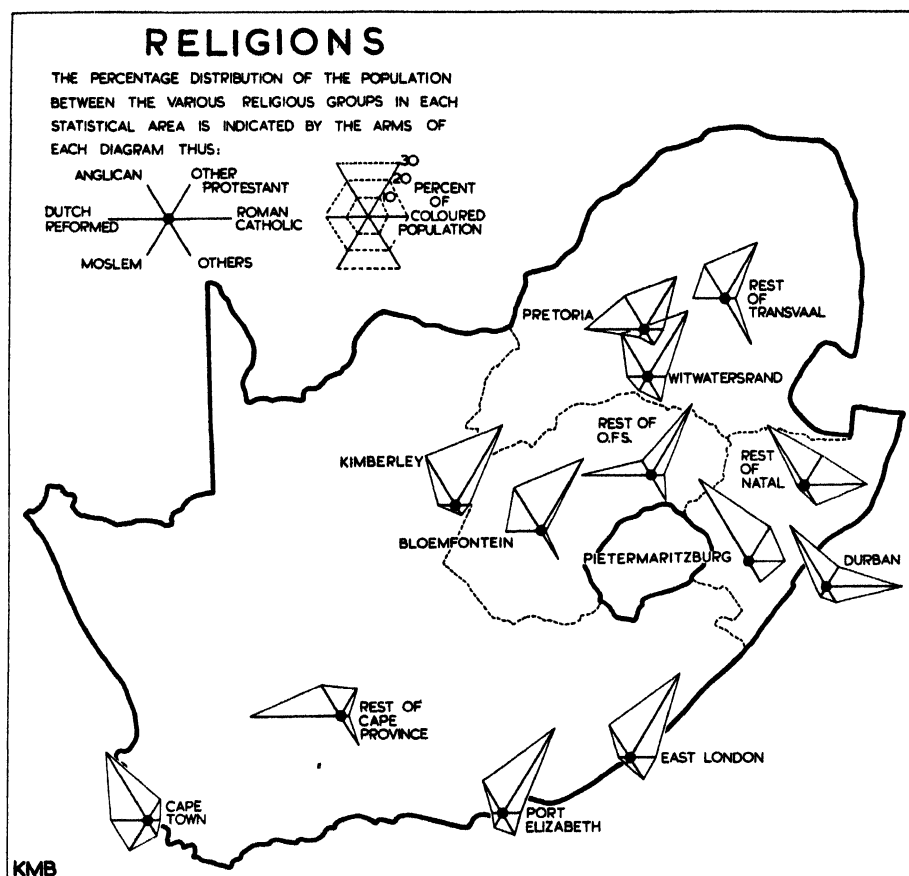


FIG. 6

Afrikaans-speaking group of 1.12 million, 1.02 million belong to the Dutch Reformed churches, whereas out of a European English-speaking group of 783,000 only 33,000 are adherents of these churches. Religion, in other words, deepens the cleavage, originally linguistic, between Afrikaner and Briton. In the Coloured community the situation is different. About nine-tenths are Afrikaans-speaking, yet only three-tenths are adherents of the Dutch Reformed churches, and even in rural areas the so-called "English-speaking" churches claim large numbers. A broad picture of the religious pattern is given in Figure 6. It will be seen that in the linguistically homogeneous Cape there are marked contrasts between Cape Town, which is dominantly Anglican, the rural Cape, which is dominantly Dutch Reformed, and the southeastern coastal cities, which adhere strongly to the "other Protestant" churches. In dominantly English-speaking Natal there is a fair balance between Anglican and Catholic churches, and the dominantly Afrikaans

population of the Orange Free State is divided between the Dutch Reformed churches and the Methodist denomination, with a strong minority adhering to the various "splinter religions," including the native Separatist churches and the "heathen" group. Provincial percentages are given in Table VI.

TABLE VI—MAIN DENOMINATIONS OF THE COLOURED GROUP, 1936

DENOMINATION	CAPE	NATAL	TRANSVAAL	O.F.S.	UNION
	%	%	%	%	%
Dutch Reformed	31.0	2.2	15.1	31.6	29.3
Anglican	20.9	36.7	23.1	11.6	21.2
Other Protestant	29.5	14.4	32.1	39.9	29.6
Roman Catholic	3.9	30.6	6.3	2.5	4.7
Mohammedan	4.7	3.2	5.2	—	4.6
Others and unspecified	10.0	12.9	18.2	15.0	10.6

Source: U.G. No. 28, 1941.

Socially, too, there are well-marked cleavages. The lowest level is the "undesirable" group that includes the "skolly boys" of the Cape Town slums; this group is in no way different from the underworld element in any large city, but it has strongly influenced European opinion on white-Coloured relations. The second level is the laboring class to which the great mass of the Coloured population belongs; it is made up of farm workers, unskilled laborers, domestic servants, and industrial workers and has had relatively close contact with the European community. The third group is small in number and includes teachers, skilled craftsmen, and a few professional men. This group has less contact with Europeans and tends to develop its own community life, apart from the lower class of Coloureds, a tendency singularly unfortunate for the Coloured community as a whole, which is thus deprived of its natural social and political leaders.

Finally, there are differences based on physical appearance, especially color of skin and length and character of hair. The more Caucasoid individuals possess a marked social advantage in that they are sometimes able to pass over into the European group.

SOCIAL MOBILITY

The color line is difficult to draw in a multiracial community such as the Union of South Africa. Many of the Coloureds pass over the thin dividing line into the European group, usually with the acquiescence and tacit approval of their own group. Seldom do the Coloureds pass over into the Bantu group.

Merging into the European community is rewarded by the social, political, and economic perquisites of the dominant group—wider educa-

tional facilities, entry without racial restriction into trades, commerce, and professions, higher emoluments, and the loss of the inferiority complex characteristic of the marginal group.

It is impossible to estimate the numbers involved in the change-over process. Fourteen years ago George Findlay, basing his conclusions on the fact that the Coloured community contained very few individuals whiter than half-caste, came to the startling conclusion that the number of escapees into the European group was at least equal to the number of persons officially classed as Coloured.⁸ This conclusion is difficult to substantiate, but there can be no doubt that "passing" is taking place on a much larger scale than most Europeans realize,⁹ and that in spite of legislative barriers designed to safeguard the purity of the white group, the color line has become hazy indeed.

THE ECONOMIC ROLE OF THE COLOURED COMMUNITY

As entrepreneurs the Coloured people have never been an economic danger to the Europeans; as traders they have never played any significant role; in commerce, finance, and industry their participation has been negligible. Traditionally they have been manual laborers, craftsmen, market gardeners, agricultural laborers, and domestic servants. But even in some of the traditional fields of employment, such as bricklaying, woodworking, and building, they have steadily lost ground, with the result that today nine-tenths are classified as unskilled laborers.

Legislation designed to support the "civilized labour"¹⁰ policy has been an important factor weakening the Coloured group in the economic sphere; so too has legislation designed to improve the lot of labor generally, for increased statutory wage rates or wages determined by industrial agreement have only too frequently tended to displace the Coloured worker in favor of the European.¹¹ The deep-seated racial prejudices inherent in the social and economic structure of the Union, together with legislative and educa-

⁸ George Findlay: *Miscegenation*, Pretoria, 1936. See also Sonnabend and Sofer, *op. cit.*, p. 23.

⁹ U.G. No. 54, 1937, paragraph 118; quoted in U.G. No. 21, 1938, pp. viii-ix.

¹⁰ The official definition of "civilized labour" is given in U.G. No. 54, 1937, paragraph 158, as follows: "Civilized labour is to be considered as the labour rendered by persons, whose standard of living conforms to the standard generally recognized as tolerable from the usual European standpoint." On the application of this policy to the Coloured community see paragraphs 154-202.

¹¹ This was especially marked in prewar days: between 1926-1927 and 1934-1935 the percentage of Coloured workers in all private industries dropped from 15 to 12, in the industries of the western Cape (1926-1927 to 1933-1934) from 52 to 46. This decrease is to be linked with the rural depopulation of the Cape midlands, which has led to increased European competition in the lower occupation grades. Increasing competition is coming also from the Bantu, who are preferred in certain trades because of their better physique.

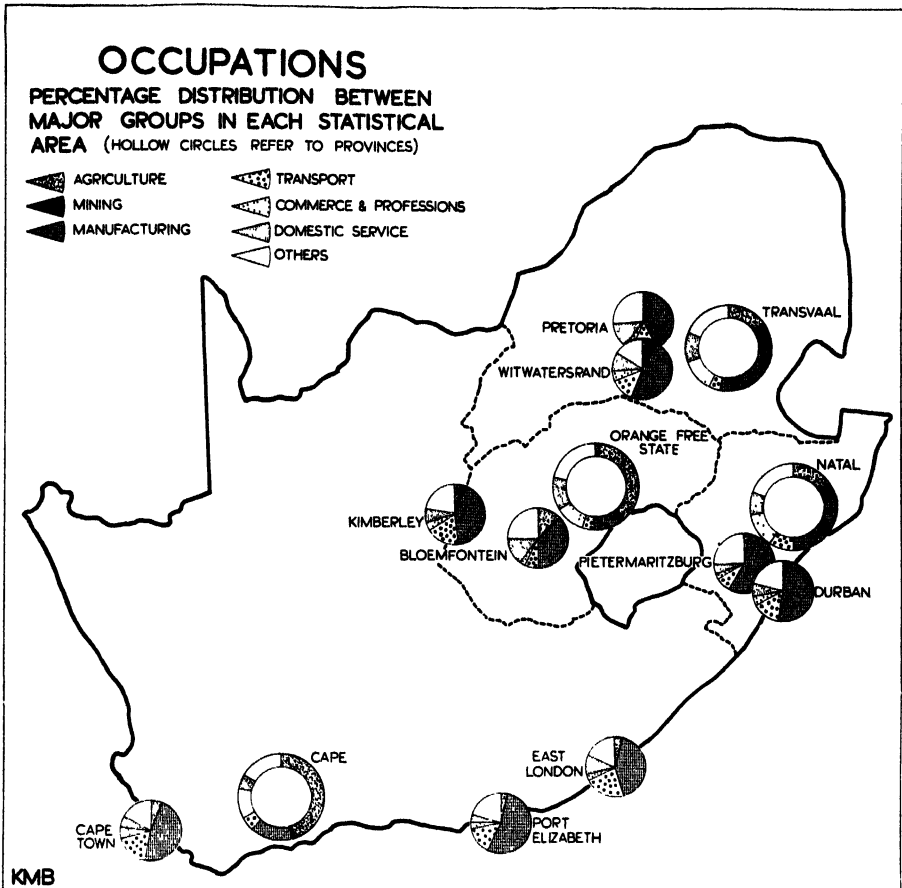


FIG. 7

tional barriers, have tended to confine the Coloured worker to the lowest income levels.¹²

The occupational structure of the Coloured population is summarized in Table VII and Figure 7; statistics for the European group are given for comparison. Some four-fifths of the Coloureds are engaged in the relatively unskilled occupations—agriculture, domestic service, and industry. In agriculture a relatively small number are independent owners, but the great majority are unskilled laborers, employed in prewar days at wage rates of 15s. to 30s. a month plus food, fuel, and water. This group is especially im-

¹² For example, the Apprenticeship Act of 1922, by prescribing certain educational standards, made it virtually impossible for Coloureds to be apprenticed in most trades. See Sonnabend and Sofer, *op. cit.*, p. 28; and U.G. No. 54, 1937, paragraphs 263-277. The Vice Principal of the Cape Technical College declared during the war that less than 1 per cent of the 3000 Coloured juveniles who seek work each year in Cape Town have an opportunity of entering a skilled trade.

portant in the Cape and the Orange Free State (Fig. 7). The second major occupation is domestic service; this employs somewhat more than one-quarter of the entire Coloured working population and no less than four-fifths of the women gainfully occupied. Slightly less than one-fifth of the Coloured working population is engaged in manufacturing, though there

TABLE VII—OCCUPATIONAL STRUCTURE OF THE COLOURED COMMUNITY, 1936

OCCUPATION	CAPE	NATAL	TRANSVAAL	O.F.S.	UNION	UNION EUROPEANS
Agriculture, forestry, and fishing	37.1%	15.1%	12.9%	32.4%	34.8%	24.8%
Mining and quarrying	0.8	2.4	6.5	0.6	1.2	6.4
Manufacturing	16.0	35.7	26.8	12.0	17.1	18.3
Transport	4.2	7.8	3.2	1.3	4.2	10.7
Commerce and finance	5.0	5.9	7.1	4.1	5.1	16.3
Administration	4.6	5.4	2.5	3.6	4.4	11.1
Professions	0.5	1.3	0.8	0.3	0.5	5.5
Personal services	25.6	18.7	32.3	37.9	26.3	4.2

Source: U.G. No. 11, 1942, pp. x and xxx.

are significant contrasts between the provinces: Natal and the Transvaal show a much higher degree of industrialization than the Cape and the Orange Free State. So far as the European is concerned, Coloured industrial competition is unimportant, since only one-tenth of the European industrial labor force (1936) is classified as unskilled.

A knowledge of this unfavorable occupational structure,¹³ in part due to, and perpetuated by, restrictive legislation, is fundamental to an understanding of Coloured poverty.

LEVELS OF LIVING

"A considerable section of the Cape Coloured belong to what may be called the socially submerged population."¹⁴ Low incomes, wretched housing conditions, malnutrition, high incidence of certain diseases, high infant mortality, and reduced expectation of life—these are some of the outstanding features of the social geography of the Coloureds.

The problem of Coloured poverty has been studied most intensively by the Social Survey of Cape Town, working under the direction of Professor E. Batson, and their findings have been released in a series of reports and studies published during the past decade. The 1938-1939 household survey revealed that no fewer than five out of every ten Coloured households in

¹³ For a detailed analysis of Cape Town's Coloured community, which corroborates the general picture given by the 1936 census, see the Official Report of the Social Survey Conference, Cape Town, 1942, especially pp. 34-36.

¹⁴ U.G. No. 54, 1937, paragraph 64.

Cape Town were below the "Poverty Datum Line"; that is, their available income was insufficient to procure "those quantities of food, clothing, fuel, and lighting and cleaning materials which are essential for the health and decency of the members of a given household."¹⁵

Investigation of housing conditions¹⁶ revealed gross overcrowding: seven out of every ten Coloured households had "inadequate" accommodation, and three or four of these were "overcrowded." The effect of this unfavorable social environment can be clearly seen in the vital statistics for the various ethnic groups of Cape Town: over the five years ended June, 1941, the Cape Coloured death rate was 2¼ times the European rate, infant mortality was three times as great, and the tuberculosis death rate was six times as great.¹⁷

How far is the state of affairs revealed by the Cape Town Social Survey representative of the Coloured community as a whole? From the report of the Cape Coloured Commission it would seem that the housing situation is almost uniformly unsatisfactory in the major urban areas and that even in the rural districts "the housing conditions of labourers on farms are far too often deplorably poor";¹⁸ Table VIII suggests that in certain respects the

TABLE VIII.—HOUSING CONDITIONS OF COLOUREDS AND EUROPEANS, 1936
Column C: Coloureds. Column E: Europeans.

	ONE-ROOM HOUSES		OCCUPANTS PER ROOM		IRON OR WOOD CONSTRUCTION	
	C	E	C	E	C	E
Cape	18.1%	1.9%	2.4	1.1	30.2%	10.9%
Natal	26.5	1.1	1.9	0.9	43.1	27.4
Transvaal	29.4	2.1	2.4	1.2	42.0	12.4
O.F.S.	43.6	1.8	2.8	1.0	53.1	7.7
Union	19.7	1.9	2.4	1.1	32.9	12.6

Source: U.G. No. 33, 1939, Tables 11 and 31. Statistics for Coloureds refer to "certain urban areas"; for Europeans, to "all urban areas and certain rural settlements."

housing situation in Cape Province was, if anything, better than in the other provinces of the Union. The Coloured infant mortality rate for the Union as a whole was 3.3 times that of the European in 1943;¹⁹ the most recent South African life tables give the Coloured male an expectation of life 19 years less than that of the European male. Thus available statistical data bear out the impression received from observation that the general level of living

¹⁵ Official Report of the Social Survey Conference (*op. cit.*), p. 33.

¹⁶ "The Housing of Coloured Households in Cape Town," *Social Survey of Cape Town Rept.* SS 24, 1944, p. 5.

¹⁷ Official Report of the Social Survey Conference (*op. cit.*), p. 100.

¹⁸ U.G. No. 54, 1937, paragraph 705. On urban housing see paragraphs 648 (Port Elizabeth), 653 (East London), 673-676 (Pretoria), and 690 (Pietermaritzburg).

¹⁹ H. Nelson: *Lives Are Cheap among the Poor in South Africa*, *South African Affairs Pamphlets* No. 15 (3rd Ser.), Johannesburg, 1947, p. 8.



FIG. 8—Coloured worker in a Constantia vineyard, Cape Province. A predominance of Khoisan (Bush-Hottentot) racial characteristics is quite evident in this man's face (Photograph by *Cape Times*.)



FIG. 9—Coloured workers in a Cape Town clothing factory. More than one-tenth of gainfully occupied coloured women in Cape Town were employed in the textile industry before the war (Photograph by *Cape Times*)



FIG. 10—Children of a Natal coloured community. They are descendants of John Dunn, a white Zulu chief of the nineteenth century, and show a mingling of Bantu and white characteristics, with occasional appearance of almost pure white types



FIG. 11—The coloured fringe in Natal. The girl at left, officially Bantu, is biologically 'coloured,' since her grandfather was European. The girl at right shows a mingling of Indian and Bantu features but is officially Bantu

among the Coloured people throughout the Union is not appreciably higher than that of the Cape Town households studied by Batson and his associates. Coloured poverty,²⁰ with its attendant tragic waste of human resources, is one of the major problems confronting the Union today.

THE DEMOGRAPHIC STRUCTURE OF THE COLOURED COMMUNITY

The Coloured population of the Union is a young one, with potentialities for rapid increase when the present limiting factors of high infant mortality and high death rate are removed. Its median age at the 1936 census was 18.9 years, as against 24.9 years for the European community; 42 per cent of the Coloured population fell into the under-fifteen age groups and 16 per cent in the under-five group; the corresponding figures for the European community were 31 per cent and 10.5 per cent.

Demographically, there are striking similarities between the so-called "Asiatic problem" in Natal and the "Coloured problem" in the Cape; for in both provinces an aging European population is established alongside a competing non-European community of high growth potential.

In Cape Province in 1936 the fertility ratio for the Coloured community was 695, as against a European ratio of 401, and the number of Coloured children was 50 per cent above that of European children. Recent figures suggest a continued strengthening of the Coloured position in the Cape.²¹

THE FUTURE

The Coloured people of South Africa are a complex and still-evolving ethnic group, which, while absorbing racial strains from all the peoples that have met and mingled at the "Tavern of the Seas,"²² has assimilated many of the forms of South African European society. It has nonetheless remained a marginal group, rejected by the dominant group, and its social and economic development has been warped and twisted by restrictive legislation. The few social and political rights that still remain to it in Cape Province are being lost through the enforcement of a rigid racial segregation that throws in the Coloureds with the great mass of the Bantu.²³

²⁰ For a discussion of the whole problem see the valuable summary by E. Batson in *Race Relations*, Vol. 9, No. 1, 1942.

²¹ In 1944 the Coloured birth rate in the Cape was almost twice the European rate (*Official Year Book Union of South Africa*, No. 23, 1946, Chap. 26 [preprint, 1947], p. 4). There were striking contrasts between the provinces: in the Orange Free State the rate was only 17 per 1000 of the estimated mean population, as against 45 in the Cape. The reasons are obscure. In the absence of migration, such differential rates will tend to accentuate the pattern of concentration in the Cape.

²² That is, the Cape Town area.

²³ On the Coloured attitude toward the native see U.G. No. 54, 1937, paragraphs 33-41.

It would be premature to attempt an assessment of the implications in the recent developments of the Union's racialist policy, but there can be little doubt that one of the major results, heavy with possibilities for the future of the continent, will be to discredit the members of the Coloured community who hold that the mission of their people is to act as a link between Black and White in the Union, and to strengthen the extremist element that would seek the salvation of the Coloureds in the formation, with Bantu and Asiatics, of a united anti-European front in South Africa.

THE DAMODAR VALLEY—"VALLES OPIMA"

WILLIAM KIRK

For the first time in the history of the nation, the resources of a river were not only to be "envisioned in their entirety"; they were to be developed *in that unity with which nature herself regards her resources*--the waters, the land, and the forests together, a "seamless web."

—DAVID E. LILIENTHAL, "TVA"

FROM July to October of 1943 the countryside south of Burdwan in West Bengal was submerged, villages were swept away and rice fields devastated, rail traffic on the lines running northwest from Calcutta was seriously interrupted, the cities of Burdwan and Calcutta were threatened by ruinous floods. Five years later, amid great enthusiasm, an act creating the Damodar Valley Corporation was passed by the Parliament of India. Linking the floods of 1943 and the legislation of 1948 are the story of a river and the growth of an idea. The river is old, with a long history of destruction and change; the idea is new. After the floods of 1943 had subsided, the Bengal government set up a Damodar Flood Enquiry Committee, which advised that nothing less than a complete catchment-basin scheme could prevent further destructive flooding by the Damodar in West Bengal. But the sources of the floodwaters lay in Bihar, in the forested hills and ravines of Palamau, where the river rises. Thus in January, 1945, representatives of the governments of India, Bengal, and Bihar met to confer on the possibility of a unified development project for the Damodar Basin—the first occasion on which provincial boundaries were overridden in the preparation of an Indian water-development scheme, and the first time that a natural region rather than an administrative unit was used as the basis of political and economic action. In 1946 the preliminary memorandum¹ of the newly created Central Technical Power Board was published, and after many interruptions the multipurpose Damodar Valley Project became, under the government of an independent India, a matter of practical policy. The project now includes, in addition to its primary function of flood control, the construction of seven great dams in the upper basin and canals that will irrigate nearly a million acres of riceland in the lower basin, the generation of hydroelectric power, the supply of industrial and domestic water, malaria control, extensive afforestation in the upper basin, and the provision of a

¹ "Preliminary Memorandum on the Unified Development of the Damodar River, August, 1945," Central Technical Power Board, 1946.

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navigable channel from the Damodar Valley coal fields to industrial Hooghlyside. The program will also attempt to stimulate regional consciousness and raise the living standards of the peoples within the 8500 square miles of the basin. Although work has only begun, there are already indications that people in other parts of India are thinking along similar lines,² and if, as seems likely, the ground plan of the future India is to be based on catchment regions, it behooves us, as geographers, to study more closely the regional economy under which the idea has matured.

PLANNING AND ECONOMY

During the war years India, in common with many other countries, was preparing blueprints for her economic and political future. In the background the National Planning Committee, which began work under the chairmanship of Pandit Nehru in 1939, slowly produced reports on the various aspects of Indian economic life, from fisheries to national housing. In 1944-1945 the Tata group set forth "A Plan of Economic Development for India,"³ which had as its central objective the doubling of the per capita income within 15 years, in order to raise the purchasing power of the huge home market for home-produced goods, this objective to be attained by ensuring full employment in a land of seasonal labor, increasing the mental and physical efficiency of the worker, fixing minimum urban and rural wage rates, and land-tenure reforms. Province and state governments submitted proposals for the development of their own resources.⁴ However, the majority of the planners made their suggestions with the concept of a united, even if possibly independent, India in mind. They did not realize the speed and direction of the political events that have divided the subcontinent along purely communal lines, laid the foundations of two nationalisms, and changed the sphere of economic planning.⁵

Nevertheless, a great deal of the original planning still makes sense.⁶

² For example, a similar scheme has been prepared for the unified development of the Mahanadi Valley, beginning with the building of the Hirakud Dam nine miles upstream from Sambalpur. Preliminary surveys are being made for a multipurpose Kosi River project, which includes the construction of a 750-foot dam across the Chatra gorge in Nepal and the irrigation of two million acres in Bihar. The valley of Assam is being similarly considered, and also many other river basins.

³ Sir Purshotamdas Thakurdas, J. R. D. Tata, and others: *Memorandum Outlining a Plan of Economic Development for India* ("A Penguin Special"), Harmondsworth, Middlesex, England, and New York, 1945 (Part 1 published separately, 1944; Part 2, 1945). The plan, which calls for a capital investment of £7500 million, is the work of a group of Bombay industrialists.

⁴ A notable example was the United Provinces' plan for settling ex-servicemen on a state-aided pioneer frontier project in the swampy Tarai jungle zone at the foot of the Himalayas.

⁵ See O. H. K. Spate: *The Partition of the Punjab and of Bengal*, *Geogr. Journ.*, Vol. 110, 1947, pp. 201-222; also his "The Partition of India and the Prospects of Pakistan," *Geogr. Rev.*, Vol. 38, 1948, pp. 5-29.

⁶ See also D. S. Nag: *A Study of Economic Plans for India*, Bombay, 1949.

Fundamentally all the planners were struggling with the age-old problem that still confronts both states—the balancing of man and land. India may clear the ground for the national planning of her resources by the political tidying up in which she is now engaged,⁷ Pakistan may or may not throw in her lot with the Moslem bloc of the Middle East and thus renew an association Alexandrian in its antiquity, but between them the two states must provide for a population that is increasing by some five millions a year in a land in which geographical values have altered surprisingly little since the period of primary agricultural settlement in Dravidian and early Aryan times. The *Pax Britannica*, which set the population growth curves soaring by reducing the Malthusian checks of famine, pestilence, and war, did not bring the industrial and agricultural revolutions by which such increase could be supported. Except for the blast furnaces of Jamshedpur, the cotton mills of Bombay and Ahmadabad, and the jute factories of Hooghlyside, India remains in essence a land of medieval villages, with an economy based on centuries of adjustment to the local environment. It is on the level of village economy that population pressure on the soil can best be seen. "Overpopulation" is a difficult and many-sided concept, to be analyzed in relation to an even more elusive and hypothetical "optimum population," but it is a condition that can be readily recognized from its effects—the decline of living standards, the inability to weather the lean years, permanent and excessive seasonal unemployment, and out-migration from affected pressure points. If such symptoms are accepted in place of precise definition, then large tracts of India must be regarded as suffering from overpopulation, including not only parts of the densely settled regions such as the Ganges Delta and the Malabar Coast but also regions of low density such as the gneissic uplands of Chota Nagpur.

It is not only the number of people to a square mile that matters, but the food-producing and work-supporting capacities of that square mile. What can give at least temporary relief from this malady? Can India take, for example, a page out of the Dutch book on Java and resort to "emigration, irrigation, and industrialisation"? In the borderlands of the Indian Ocean emigration across international frontiers is becoming increasingly difficult as old peoples develop into young nations and as doors are closed to foreign capital. No *Tanah Sabrang*⁸ awaits the Indian overseas colonist,

⁷ See Government of India White Paper on Indian States, July, 1948, under which 174 states have merged with adjacent provinces of Bombay, Madras, East Punjab, Bihar, Orissa, and the Central Provinces; 217 states have formed the Unions of Saurashtra, Matsya, Rajasthan, Patiala and East Punjab States, Vindhya Pradesh, and Madhya Bharat; and 22 states have formed the two centrally administered states of Kutch and Himachal Pradesh.

⁸ "The Land Beyond." See K. J. Pelzer: Pioneer Settlement in the Asiatic Tropics, *Amer. Geogr. Soc. Special Publ. No. 29*, 1945, p. 189.

and at home new boundaries add fresh complications to movement into virgin lands. Nor do such lands exist in abundance; for with the exception of the forested perimeter of the Ganges-Brahmaputra basin, the drier jungles of peninsular India, and the communal wastelands most of the suitable agricultural lands have long been settled and the dangers of submarginal farming recognized. Extension of cultivation must be carried out largely at the price of dwindling forests and resultant accelerated soil erosion. The reduction of wastelands and commons within the old settled areas will raise the same problems as the enclosure movement did in Britain.

Greater possibilities for increased food production lie in intensification of agriculture. Rarely in India is farming as intensive as in the irrigated terrace lands of Java, and a perennial water supply would certainly reduce the idleness of land and man imposed by the long dry season. But soils are a strong limiting factor. In many areas of suitable soils double cropping is already practiced. Improvement in farming methods and the introduction of modern implements, though helpful, also have their limitations; as Talents correctly pointed out in the Census Report on Bihar and Orissa for 1921, "it is extension and not increased efficiency of cultivation that leads to an increase of the agricultural population, in so far as increased efficiency involves the use of labour-saving devices and the economy of man-power." In view of these restricted possibilities of increasing the gross area of cropland, and the enormous problems voluntary birth control would mean in a country such as India, it is not surprising that the Indian planner looks toward a change in the character of work to check the growing unbalance of man and land. The vision of an industrial India, the production center for Near and Far Eastern markets, exporting work instead of soil and men as in the past, is dear to his heart.

Although considered one of the first twelve industrial nations of the world, India ranks well below even Mexico if units of electrical power generated per capita are taken as the criterion of the stage reached in industrial development. Despite rich resources in minerals, including some of the largest reserves of high-grade iron ore in the world,⁹ and in vegetable fibers and animal products, the realization of India's industrial dream must rest ultimately on her latent power resources. The relative values of these vary enormously. With ever increasing consumption of petrol, fuel oil, and kerosene the 30 million gallons of petroleum produced annually from the Tertiary coal measures in the Digboi area of Assam has become progressively

⁹ It is estimated that in Singhbhum and adjacent eastern states there are reserves of some 8000 million tons of ore containing more than 60 per cent iron at or near the surface ("The Mineral Wealth of India," *Indian Minerals*, Vol. 1, 1947, pp. 3-8; reference on p. 5).

insufficient. The Attock oil fields of the Potwar Plateau and the potentially oil-bearing tracts of the Chittagong region now lie in Pakistan. Until a marked decrease in world oil supplies makes it economically advisable to work her oil shales and convert the sugar and starch of agricultural products into power alcohol,¹⁰ India must depend on the purchase of petroleum from the Middle East, Burma, and the United States.¹¹ With respect to coal, her position is better—total production in 1943 was 25,511,909 tons—and the new frontiers have made no appreciable difference, since some 69 per cent of the output came from the Gondwana fields of West Bengal and Bihar alone. But although the supplies of coal appear enormous, high-grade reserves are in fact extremely limited.¹² In view of wastage at the pit head, loss of quality by distant transport in a hot climate, and the indiscriminate use of better-grade coals for steam raising on the railways (which absorb 38 per cent of production), no long-term industrial development can be planned without the strictest conservation.

Thus once more the planner falls back on water as the solution to the power problem. He sees in the huge streams discharged each year down the steeply graded valleys of the Himalayas and the Western Ghats and in the water pouring across the old tilted crustal block of peninsular India into the eastern land of the great deltas an immense potential of power as yet insignificantly harnessed. Hydroelectric surveys of India there have been,¹³ and even if their estimates are regarded as merely "intelligent guesswork," the total installed capacity of 553,015 kilowatts computed from the 1947 Power Map of India¹⁴ must represent an infinitesimal percentage of the power available. Only 10,600 kilowatts of this amount must be credited to Pakistan;

¹⁰ It is possible that some 15 million gallons of power alcohol could be produced from the surplus molasses, and a further 3 ½ million gallons by processing the flowers of existing mahua trees (see below p. 433).

¹¹ See D. N. Wadia: Petroleum Resources of India, *Indian Minerals*, Vol. 1, 1947, pp. 221-227, and Vol. 2, 1948, pp. 5-10; also E. H. Pascoe: Petroleum Occurrences of Assam and Bengal, *Memoirs Geol. Survey of India*, Vol. 40, Part 2, 1914.

¹² C. S. Fox (The Lower Gondwana Coalfields of India, *Memoirs Geol. Survey of India*, Vol. 59, 1934, pp. 344-345) estimated that in the Lower Gondwana coal fields alone, in seams more than four feet thick and within 1000 feet of the surface, there was 20,000 million tons of workable coal. But even within a depth of 2000 feet, only 5000 million tons could be considered of good quality, and the reserves of good coking coal (all in the Damodar Basin) amounted to only 1500 million tons. Contrast this with the iron ore available.

¹³ On the recommendation of the Indian Industrial Commission of 1918 a hydroelectric survey of India was undertaken under the direction of J. W. Mears. Reports on the water-power resources of India and Burma were made in 1919 and 1920.

¹⁴ "India, Showing Existing and Projected Power Stations and Main Transmission Lines," 1 inch to 70 miles (1 : 4,435,200), Survey of India, 1947. For further details of electricity installations, thermal and hydroelectric, see Shiv Narayan: Hydro-electric Installations of India, Poona, 1922; George Kuriyan: Hydro-electric Power in India—A Geographical Analysis, *Indian Geogr. Soc. Monograph No. 1*, 1945; Report of the National Planning Committee on Power and Fuel, October, 1947.

of the remainder the power plants on the Western Ghats behind Bombay supply 243,024 kilowatts and those of the Cauvery basin 137,650 kilowatts. To the Indian economist the tapping of this huge potential to make cheap electricity available over wide areas would be especially welcome, since it would make industrialization possible without conurbation. The chief characteristic of industrial location in India has been the concentration of factory industry on the two foci of Calcutta and Bombay and the wide dispersion of cottage industry.¹⁵ In spite of the Swadeshi movement and the recent gradual spread of factories from the seaboard into the interior, the old industrial concentrations continue to develop "halos" of slums housing great numbers of unskilled laborers who are surplus to the rural economy and parasitic on the urban economy. Such slums appear to support Gandhi's philosophy that urban industrialization is by nature an evil thing.

From whatever angle the fundamental problem of India is approached the key seems to lie in the greater use and more efficient distribution of its waters; hence the importance attached by the National Planning Committee to its recommendation that as a necessary preliminary to economic planning a thorough survey of the drainage basins of the country be carried out. Life and water are indeed synonymous in India; the organization of one must be expressed in the organization of the other. The catchment basin is the vital natural region, if one defines a natural region not so much on the basis of similarity, which is a generalized myth in any case, but of *process*. It can be considered a unit in which, according to the second law of thermodynamics, the interplay of forces strives toward an equilibrium in which stress and energy are at the minimum and into which come human groups to disturb or sustain the natural processes. It can also be considered a *Gestalt*, in which the whole is greater than the sum of the parts, and yet in which the alteration of one part affects the whole. Few other natural units have played so important a role in the historical geography of India, and the fact that the modern economic planner has reaffirmed the potency of the drainage basin as a basis for human endeavor is of great significance. It is clear that the economic situation of India has created the need for such an approach; now what of the region that has shown the way?

THE UPPER BASIN

The Damodar Basin above Asansol differs considerably from the lower basin in West Bengal. Twelve miles upstream from Asansol the Damodar

¹⁵ See Tulsi Ram Sharma: *Location of Industries in India*, 2nd edit., Bombay, 1948; P. C. Jain, edit.: *The Industrial Problem of India*, Allahabad, 1942.

receives its main tributary, the Barakar, and together the two rivers drain a considerable area of the Chota Nagpur Plateau—the “Wales” of India in more than one sense. Stamp, Baker, and Ahmad¹⁶ class this plateau as a subregion of the North-Eastern Plateau of peninsular India, but its surface features are far from uniform. A part of “old” India and a land mass long before the sediments of the Tethys Sea were upfolded to form the Himalayas, the plateau has had a varied geological history. The main features may be summarized thus: a long period of erosion evening out the irregularities of a gneissic and granitic pre-Cambrian land surface; an ice age in the Upper Carboniferous; major trough faulting in Permian time, when the Lower Gondwana rocks were laid down under fresh-water lakes; uplift in the hot desertic conditions of Triassic days, when some five thousand feet of unprotected Lower Gondwana sedimentaries were stripped away and the massive sandstones of the Mahadeva series (Middle Gondwana) were formed; a volcanic outburst in the Jurassic; and minor faulting and tearing during the Tertiary earth movements. All these have left their mark in the grain of the landscape, but undoubtedly of greater importance is the erosion that has been going on from Cretaceous time to the present. Unprotected sedimentary rocks, including in places some two thousand feet of the Upper Gondwana series, have been worn away to expose old gneissic surfaces. These too have been remodeled by the erosive force of subtropical weathering and the action of streams cutting back from the Gangetic foredeep and the Bay of Bengal; in the neighborhood of Parasnath Hill, for example, some four thousand feet of gneiss and other Archean rocks have been removed. The stages of erosion corresponded to fluctuating base levels in the Tertiary and the Pleistocene, one of the more recent of which is evidenced by the peat and lignite deposits of the Ganges delta. The stages are reflected not only in the lower breaks of slope in the long profiles of the rivers at 675 feet and 925 feet (see Fig. 8) but also in the higher mature erosion surfaces at about 1250 feet, 2000 feet, and 2500 feet in the western Damodar Basin.

A physiographic block diagram (Fig. 2) drawn from a point on the watershed of the Damodar eight miles west of Hazaribagh shows the 1250-foot (B) and 2000-foot (C and E) surfaces and the trough-faulted valley of the Damodar (D). The lower surface today forms a broad undulating plateau drained by the Barakar River, with terraced valleys and a sky line broken only here and there by isolated relict hills. The plateau widens as it

¹⁶ L. Dudley Stamp: *Asia: A Regional and Economic Geography*, 6th edit. [1946]; J. N. L. Baker: *Notes on the Natural Regions of India, Geography*, Vol. 14, 1927-1928, pp. 447-455; Kazi Ahmad: *Physiographic Divisions of India, Indian Geogr. Journ.*, Vol. 16, 1941, pp. 257-267.

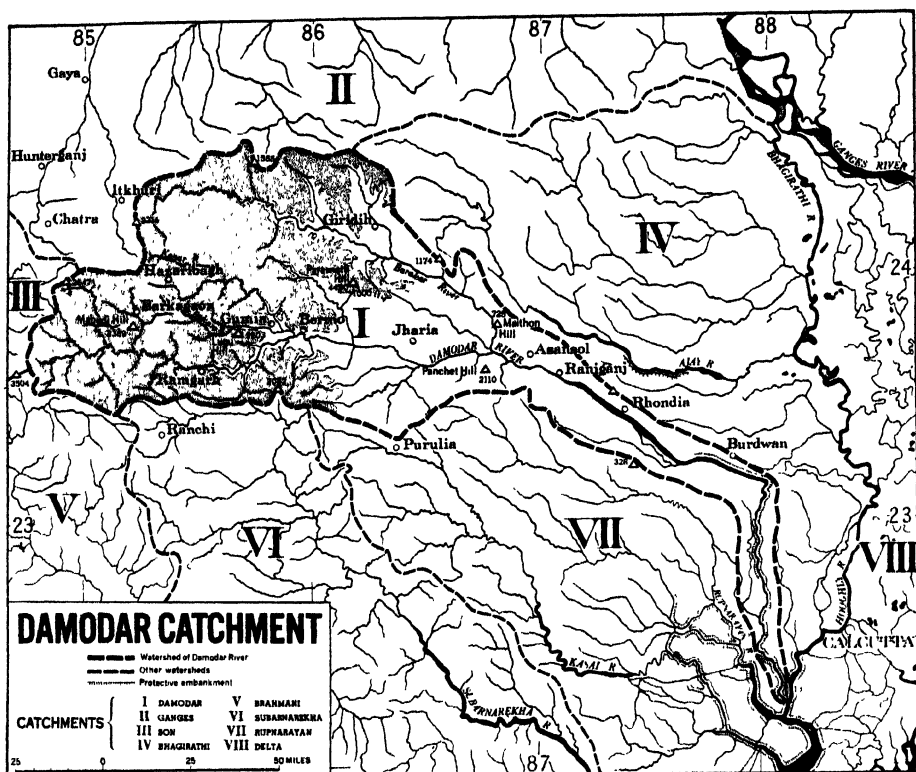


FIG. 1—Catchment basin of the Damodar in relation to the general drainage of the Chota Nagpur Plateau. The Brahmani and Subarnarekha Rivers drain to the Orissa coast, the rest to the Ganges. Note the contrast in stream pattern between the plateau, the alluvial fans that skirt it to the east and north, and the delta. Land over 1000 feet in the basin is shaded.

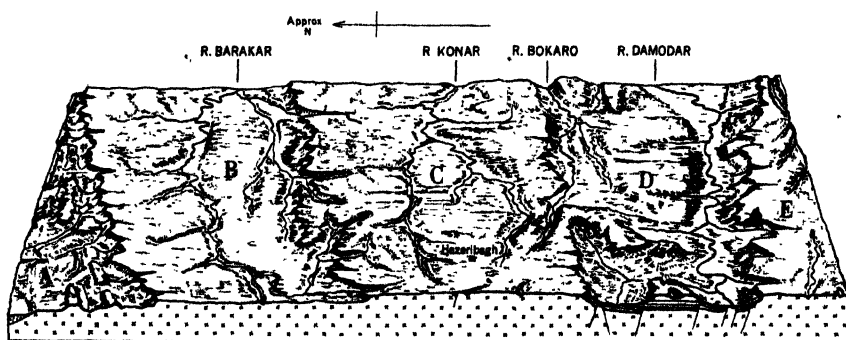


FIG. 2—Physiographic block diagram of part of the upper Damodar Basin, showing the broken country of northern "ghats" with skirt of alluvial and detrital fans (A), the 1250-foot (B) and 2000-foot (C and E) surfaces, and the trough-faulted Gondwana sedimentary basins (D).

sinks eastward toward the base of the volcanic Rajmahal Hills. The dense sal forest that originally covered it has been replaced by open scrub jungle, with a marked scarcity of surface water away from the main streams. To the north this lower plateau is bounded by broken badlands (A) where the tributaries of the Ganges have cut back into its surface. The steep, forested scarps of the plateau and its outliers, the scrub-covered gravel scree, the deep ravines and sandy beds of intermittent streams have interposed a barrier between the plateau and the alluvial plains of Bihar. To the south the land rises to the higher plateau surface (C) on which Hazaribagh stands, the administrative center of the upper basin. Again the even levels of an old erosion surface are apparent, sinking eastward toward the base of the resistant granulitic mass of Parasnath Hill (4481 feet) and stretching out great spurs into Manbhum District. The main river is the Konar, which rises near Hazaribagh and flows in a steeply graded bed through the wastes of scrub jungle north of Gumia to join the Damodar above Bermio. It receives the waters of the Bokaro, which also rises on the plateau but for most of its course skirts the southern face, in a deep and beautiful valley. Over large tracts of this higher plateau the original vegetation of semixerophytic trees and shrubs, deciduous through part of the long dry season, has given way before the upland cultivator; it is preserved only in the semisacred village groves, on the steep edges of the plateau, in the broken country to the west near the Hazaribagh-Palamau border, and in a small "island" of Himalayan flora on the summit of temple-crowned Parasnath. Across the trough of the Damodar Valley (D) to the south this surface is matched in elevation and character by the "Tanr Raj"—the cultivated upland of the central Ranchi plateau (E). Ranchi waters are for the most part drained southward by the headstreams of the Brahmani and eastward by those of the Subarnarekha, which falls 243 feet from the plateau at Hundru into the "Land of the Five Parganas" before turning south to the Orissa coast. In the western part of the plateau there are some remarkable hill features known locally as "pats." Their uniformly flat summit levels (approximately 2500 feet) suggest a possibly higher surface, less definitely indicated to the north in the broken hill country of the Damodar River headwaters.

Here, then, in the plateau levels, are the traces of older and higher surfaces of past cycles of erosion, into which the rejuvenated rivers of the region have cut and on some prototype of which they were probably consequent. But the picture is complicated by the fact that some of the rivers, especially the Damodar itself, have adjusted themselves to the lines of the Permo-Triassic trough faulting. The reason is not so much that the main

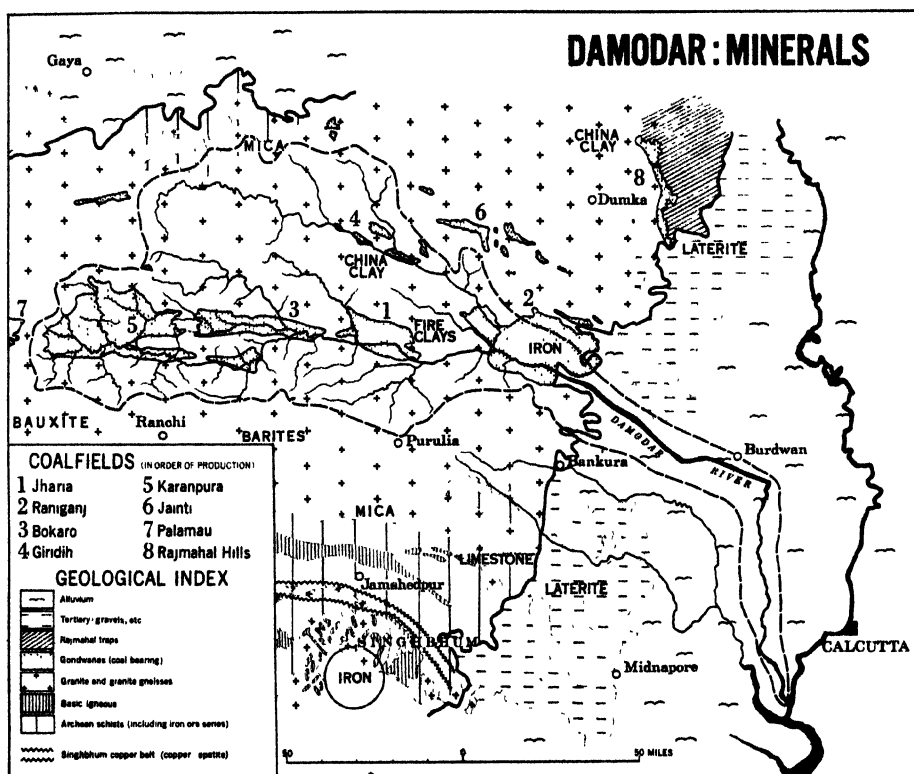


FIG. 3—Mineral deposits, showing the five important coal fields. The rich mineral zone of eastern Singhbhum is also shown, including the copper belt where ores of copper and apatite veins occur in soda-granites associated with thrust zone. Circled "iron" represents ore of Gorumahisani; "iron" in Raniganj coal basin represents weathered ores of ironstone shales. In addition to minerals shown, asbestos, chromite, steatite, vanadium, and mineral pigments occur in workable quantities.

boundary faults of the Gondwana basins have been in themselves relief builders as that the fluvialite Lower Gondwana sandstones and shales are more easily eroded than the metamorphic rocks. Where the troughs contain resistant rocks of the Upper Gondwana, relief rivals and sometimes exceeds that of the adjacent gneissic landscape. For example, south of the Raniganj coal field the hard sandstone mass of Panchet Hill (2110 feet) rises some 1500 feet above the surrounding countryside on the downthrow side of the 9000-foot south boundary fault of the basin; and in the Karanpura basin, Mahudi Hill, composed of resistant Mahadeva sandstones and conglomerates in the center of the trough, matches in height the Hazaribagh and Ranchi plateaus to the north and south (Fig. 2). However, when once the crust of more resistant cover rocks is broken, the internally faulted synclines of gently south-dipping sedimentary rocks form lines of weakness. One of these may be traced in Figure 3, namely that formed by the Raniganj, Jharia, Bokaro,

North Karanpura, and Palamau coal fields. To the south a parallel line includes the Ramgarh and South Karanpura fields, and to the north a less definite line probably links Giridih westward via the small basins of Chope, in the western part of the Hazaribagh plateau, and Itkhari with Daltonganj and the major Narbada-Son trough. Through the Karanpura basin the Damodar follows the southern line of weakness represented by the south Karanpura coal field; it shows a tendency to work down the dip slope of the Lower Gondwana rocks toward the scrub-covered gravel piedmont of the south boundary fault. Immediately to the north stands Mahudi Hill, covering unconformably a central internal trough, and river erosion has again opened the basin to form the Barkargaon Valley at the southern foot of the Hazaribagh plateau. From South Karanpura the Damodar flows eastward over a short stretch of metamorphic rocks to enter the Ramgarh basin. So far the southern zone of weakness has been the main structural determinant, but south of Lugu Hill the river turns sharply to the north to enter the middle zone, which has been used in its western section by the Bokaro River and from the Bokaro coal field to Raniganj is followed by the Damodar. The sudden swing from one zone to the other can perhaps be explained by river capture in which the upper Damodar drainage was beheaded by a southern tributary of the proto-Bokaro that cut back through the metamorphic rocks separating the two zones; this theory is supported by the wide cultivated valley that runs southeast from the Ramgarh elbow and probably represents the original line of drainage of the lower Damodar.

The upper Damodar catchment basin, then, is a region in which youth and maturity go hand in hand. Primeval forests, which earned for the region the Aryan and Mogul appellation of "Jharkhand," give way to new upland cultivation.

Over most of the upper basin the mean annual rainfall is slightly more than 50 inches, of which 80-95 per cent falls in the monsoon months June-October, usually as heavy thunderstorms. These storms range from the normal afternoon showers resulting from the intense heating of the plateau surfaces to violent cyclonic storms that pass northwest from the Bay of Bengal. At the beginning of the monsoon season one can at times literally smell the approach of a cyclonic storm. Pressure drops, high cumulus clouds billow up over the southeast horizon, light winds from the north strengthen and set the thick sal leaves whispering, filling the air with the accumulated fetid dust of the dry season. The heavy downpours of such storms make average annual rainfall figures appear somewhat ridiculous. In 1911 storm rain amounting to 30.49 inches was recorded at Hazaribagh between June 5

and 25; on the 24th the fall was 9.8 inches. The total rainfall registered at the station in that year was 75.24 inches—24.72 inches more than the average. Another great storm, which was centered over Hunterganj, to the west of the basin, is shown in Figure 4. With the coming of the rain temperatures drop slightly from the hot-season levels and nights become cooler, though even in the cold season frost is never a danger to the cultivator except in the high lands of Palamau and in deeper valleys subject to temperature inversion. The warm, sticky days that follow each storm set insect life on the move, including myriads of termites, flying ants, and red-backed burying beetles. Some of the rainfall is lost by evaporation; some goes underground in the areas of sedimentary deposits and fissured metamorphics, to reappear in the spring lines of the Gondwana basins or in isolated springs where an obstruction in the gneiss ponds back the water; but by far the greatest part becomes runoff from the large impermeable tracts. In the later monsoon season runoff coefficients of 84 per cent have been calculated after storms. River levels quickly reflect the intensity of rainfall, as may be seen from the graphs of weekly discharge at Rhondia (Anderson Weir) (Fig. 5), where stream-flow records have been kept since 1933.¹⁷ The graph for 1940 represents the more nearly normal yearly river regime, that for 1942 the maximum average annual discharge during the period, in which the average flow was 14,600 cusecs. The graphs reveal a river that at one time is a rushing torrent with an average weekly discharge of 128,300 cusecs (a peak flow of 650,000 cusecs was recorded in August, 1935) and at another time is a mere string of pools on a sandy bed with a zero discharge.

THE LOWER BASIN

But now let us turn from "Jharkhand" to "Rahr," by which name the alluvial plains west of the Bhagirathi were anciently known. From Asansol the Damodar flows southeastward to Burdwan, where it turns sharply to the south; 35 miles south of Calcutta it enters the Hooghly opposite Falta. Beyond the Permian sedimentaries of the Raniganj coal field it begins to flow on new alluvium of its own creation; it widens as it passes through the lateritic gravels and old alluvium that border the hill lands in western Rahr; and by the time it reaches Hooghly District it has become a typical sluggish deltaic stream. The watersheds in its lower course demarcate not so much the rain catchment area, which is bounded in some districts by artificial features such as railway embankments or flood-control "bandhs," as the zone of subterranean infiltration during the dry season. As the Hooghly is

¹⁷ The date of the opening of the Damodar Canal.

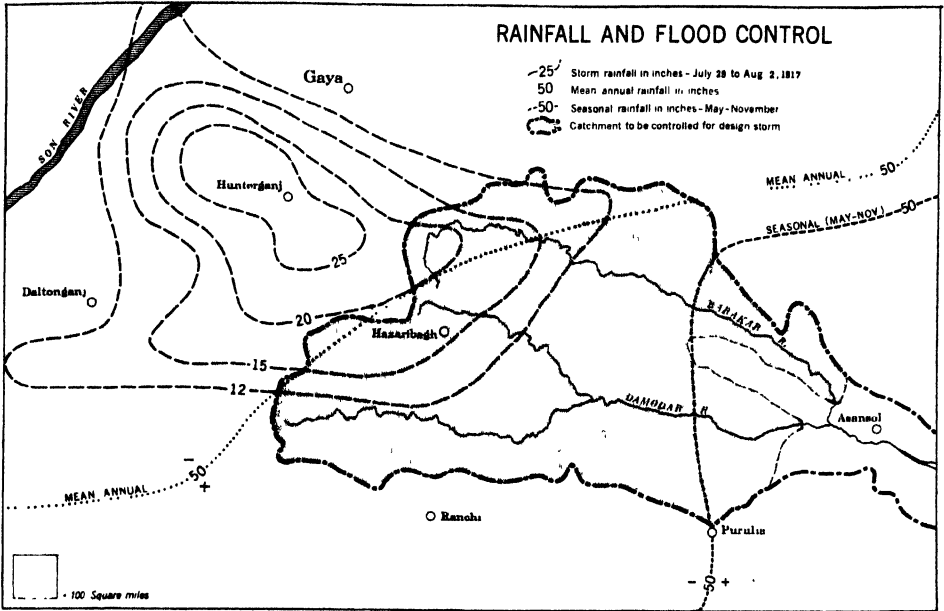


FIG. 4—Average annual and wet-season rainfalls over the upper basin. The storm rainfall shown is the most intense fall recorded in the vicinity and has been used to estimate the storage necessary to control runoff of a “design storm” centered over the basin.

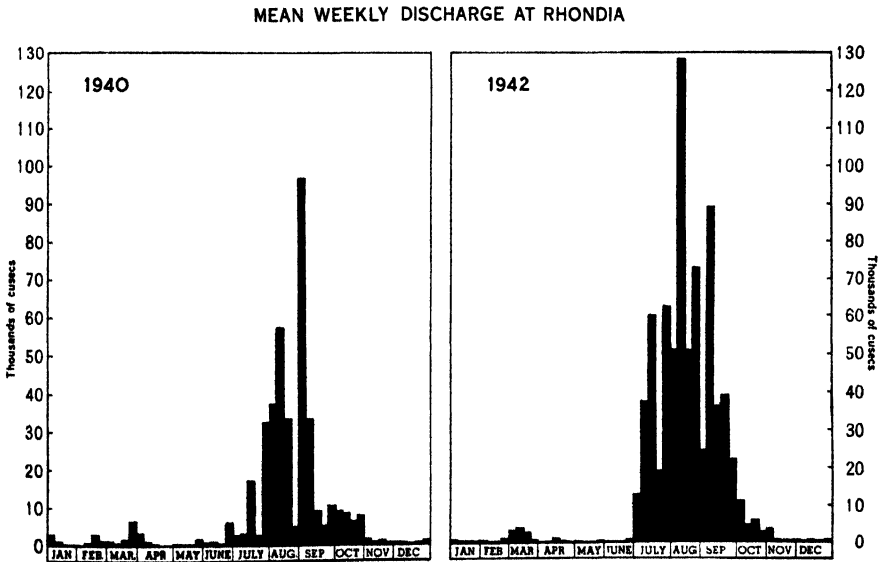


FIG. 5—River regime at Anderson Weir, Rhondia. River flow reflects the rapid runoff of storm rainfall from the deforested gneissic surfaces of the upper basin.

approached, the water table rises; rainfall increases eastward from an annual average of 54 inches in western Burdwan to 57 inches in Hooghly and Howrah Districts. These changes in water supply find a response in vegetation. In the west sal forest and scrub jungle of zizyphus and other thorny shrubs extend from Chota Nagpur onto the higher lateritic hills; on the lower hills they are partly replaced by dense mixed forest in which tropical species are more numerous; and finally they give way to the swamp vegetation of the West Bengal rice plains, with village groves of banyan, pipal, bamboo, red cotton trees, and a variety of palms.

The surface of the rice plains, which are built of the coalesced deltaic fans of the streams flowing from the western hills, appears at first glance monotonously even, but closer examination reveals evidence of recent hydrographic change, much of which can be corroborated by historical record.¹⁸ The river courses are as unstable as the water-sorted deposits on which they flow, and the earth, like a huge photographic plate, records the changing stream pattern. Old river courses are shown by strings of "bhils," shallow fresh-water lakes that are gradually choked by aquatic plants, or by pieces of detached ancient levees. The Damodar River has not escaped such change, and the great elbow below Burdwan is a clue to its history. Formerly it joined the Hooghly at Naya Sarai, 39 miles above Calcutta, and its old mouth is still marked by the Kansona Khal, but during the eighteenth century its floodwaters tended to spill southward toward the Rupnarayan; finally, in the great flood of 1770, which almost destroyed Burdwan, the river abandoned its old embankments and turned south to its present outfall. Other heavy floods, especially those of 1823 and 1855, affected the lowlands between the Rupnarayan and the Hooghly, and protective embankments were constructed along both banks of the Damodar. The embankment along the right bank, however, was found to be too costly to maintain, and today only the left-bank bandh remains to protect the low interfluvium between the Damodar and the Hooghly (Fig. 1). But overabundance of water at one time is counterbalanced by lack of fresh flushing water at another in this land of a dying delta.¹⁹

The change in the course of the Damodar was preceded by a reorientation of the Ganges in the sixteenth century when it turned southeast, via the Padma, to give an ever increasing proportion of its silt-laden waters to the eastern distributaries of the delta. The Hooghly has deteriorated, but the

¹⁸ See W. H. Arden Wood: *Rivers and Man in the Indus-Ganges Alluvial Plain*, *Scottish Geogr. Mag.*, Vol. 40, 1924, pp. 1-16.

¹⁹ See Arthur Geddes: *The Regions of Bengal*, *Geography*, Vol. 15, 1929-1930, pp. 186-198.

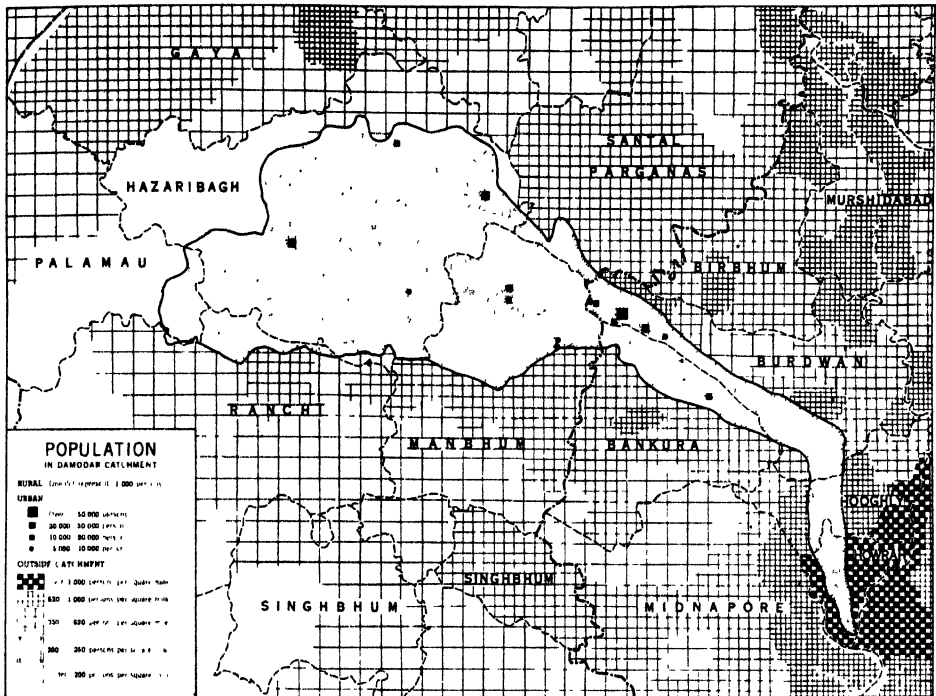


Fig. 6—Rural and urban population are plotted separately, with a figure of 1000 persons serving as the dividing line, but urban rank as well as size has been considered. In the case of the rural population, each dot representing 1000 persons was located in relation to the settlement net of each "thana," as shown on the one-inch and quarter-inch Survey of India maps. Relative densities of population outside the basin (by thanas in Bihar and police circles in Bengal) indicate areas of demographic dominance that have influenced settlement and economic development within the basin and provide the principal markets for its products.

fears of the governors of Calcutta that it would cease to provide a navigable channel have been allayed by the increase of tidal scour. Nevertheless, the building of sand bars by the tributaries—for example, the James and Mary shoals opposite the mouth of the Rupnarayan—makes the approach to Calcutta tricky and has resulted in one of the finest pilot services in the world. Less spectacular, but in the long run more evil, has been the decline of soil fertility in the areas that once received an annual deposit of fine silt, and the associated increase in salinity and spread of diseases dependent on stagnant pools.

POPULATION AND SETTLEMENT

Five million people inhabit the 8500 square miles of the Damodar catchment area (Fig. 6). It was Jean Brunhes who maintained that of all the maps a geographer can use the two most significant are a rainfall map and a population map—water and life. How far can the life represented by Figure 6 be correlated with the distribution of water examined above? The

dense populations in the lower basin and in the valleys of the upper basin suggest that the correlation is indeed close, but such features as the concentration of urban population in the vicinity of Asansol and of rural population in certain parts of the valleys need further explanation. For the pattern of distribution represents a synthesis of two patterns of occupation—the first associated with the opening up of primeval forest by agricultural pioneers, the second with an emergent landscape of coal.

"The jungle is always with us" might have been until recent times the watchword of the agricultural settlers of the upper basin. It was the forested plateaus of Jharkhand and the lateritic scree of the jungle mahals, as well as the broken hill country, that isolated the region for some two thousand years from the growing agricultural civilizations of the surrounding plains. While the axes and plows of the Hindu-Aryan villagers gradually transformed the Mahavana, "the dark and pathless forest" through which Rama and the Pandavas of the Epics roamed, into the great cultivated plain of today, the plateaus and valleys of Chota Nagpur remained comparatively isolated—a refuge alike for ancient peoples and ancient cultures. The high jungle country lay as an obstacle between the "Middle Land" of the Ganges basin and the delta, lending great strategic significance to the narrow zone of old alluvium that runs between the northernmost hills of peninsular India and the Ganges, and on the few ways across Chota Nagpur that gave access to Bengal's back door. Often conquered but rarely subdued, the upper Damodar Basin became of increasing importance for the passes through the broken lands of the northwestern watershed. Those who traveled these ways, whether Mogul armies marching southeast toward insurgent Bengal, or British armies marching northwest to the Afghan wars, or Hindu pilgrims on their way to the bathing ghats of Benares, had destinations that lay beyond the basin. It long remained a country of aboriginal peoples and Hindu hill rajas who ruled over them from migrant capital cities in embryo, the deserted ruins of which are found in many localities. The roots of its culture go deep into a Neolithic past of hunting, collecting, and shifting agriculture, when it was more closely associated with Southeast Asia than with the ocean-borne megalithic cultures of peninsular India.²⁰ Its ancient slag heaps bear testimony to the activities of the Agaria,²¹ who were possibly the descendants of the Asuras, enemies of the gods, and who worked laterite

²⁰ On the cultural relationships of Chota Nagpur in contrast with the cultural orientation of southern peninsular India see Christoph von Fürer-Haimendorf: *The Problem of Megalithic Cultures in Middle India*, *Man in India*, Vol. 25, 1945, pp. 73–86; V. Gordon Childe: *Megaliths*, *Ancient India*, No. 4, 1947–1948, pp. 4–13; and R. E. M. Wheeler: *Brahmagiri and Chandravalli 1947: Megalithic and Other Cultures in the Chitaldrug District, Mysore State*, *ibid.*, pp. 180–310.

²¹ Verrier Elwin: *The Agaria*, Oxford University Press, 1943.

and the iron ores of the middle Damodar measures in small clay furnaces and brought the age of stone to an end. The peoples of the basin have traditions²² of ancient wanderings in a forest environment before the ax gave way to the plow. The key to the pattern of rural settlement is to be found in the pioneer fringe that extended fixed-field agriculture at the expense of "jhum," or shifting cultivation, and supported not only the Hindu plainsman but the economically converted aborigine.

Among the pioneers first place must be given to the Santals. Whether these Munda people came into India from the northwest and moved steadily eastward or, as is more generally accepted today, from the east, penetrated as far as Benares, and recoiled before the pressure of peoples from the northwest, it is perhaps safe to say that they entered our region from the western watersheds. While associated groups turned south, the Santals found a home in the valley of the Damodar, their sacred river. In their initiation ceremonies they recite: "Let us settle here: we have found primeval jungle and virgin soil." The movements of this people as they passed northeastward to their present stronghold in the Santal Parganas and spilled over into the quasi-lateritic tract of the Barind during the nineteenth century and the early twentieth can be closely related to the distribution of lateritic soils. As reclaimers of jungle they are second to none, for as Sir H. Macpherson²³ has pointed out:

The Santal is a born reclaimer. He has an eye which is expert to take advantage of the inequalities that exist in the surface of the country. He knows where to throw his cross-bandhs, and where to make his terraces. He loves to clear jungle and in areas that are now almost Hindu he has often been the pioneer. . . . In the older areas from which he moved on at an early date he seems to have done the first clearing of jungle and the first rough shaping of slopes and levels. The more civilised Bengali, Bihari and up-country immigrant came at his heels, pushed him off the land by force, cajolery and trickery, seized upon his improvements and by the application of larger capital and steadier labour developed the embryo bandhs and tanks into works of considerable size.

The Santals possess, in fact, a "geographical eye for country," and it was they who laid the ground plan for agricultural settlement in many parts of the upper basin. It is not surprising, then, that the agricultural villages there bear the marks of their pioneering both in form and in economy.

THE AGRICULTURAL PATTERN

Availability of water was the controlling factor in village location, and

²² For analysis of these traditions see Census of India, 1931, Vol. 7, Bihar and Orissa, Part 1, Report, Patna, 1933, pp. 288-300.

²³ Sir H. Macpherson: Report on Settlement Operations in the District of Santal Parganas 1898-1907, p. 138.

the river valleys, the spring lines of the Gondwana sedimentaries, and the zones of fissure springs in the gneiss country were areas of primary settlement. Colonization was usually carried out by small interrelated groups, who chose some small elevation overlooking a stream or a spring as a base from which to clear the surrounding jungle. Their dwellings, built at first of interwoven branches and later of dried mud, with windowless walls and overhanging thatched roofs, either huddled together or, where a ridge site was used and Santal influence was strong, formed long, straggling ribbon villages with each hut facing away from the ridgeway. Each village to some extent repeated in abbreviated form the economic development of a thousand years; for it gained its living by "jhum," planting maize in small enclosures fenced with sal saplings, and "gangai" and "kurthi" (pulses) in the ashes of burnt forest clearings until the ricelands were ready.

The ricelands were prepared in various ways. Sometimes an embankment was constructed across a side valley, and when deposition of silt had raised the stream bed to the level of the embankment, additional bandhs were built upstream until the valley became a series of rice terraces, with the stream diverted to an artificial channel alongside. Where this was not possible, terraces were built by hand—a prodigious undertaking, both in construction and in maintenance. Where water supply was a problem, tanks were excavated, or a natural hollow was embanked to store surface water for irrigation by percolation through the earthen bandhs. Rice culture then became the keystone of the village economy and the controlling factor in the agricultural round of the year. It is an interesting confirmation of the central place of the availability of water that the Revenue Settlement Reports use elevation as the criterion for assessment of these "don" or wet ricelands. Thus the most valuable village lands are the lower terraces, where water is available for a longer period and the late-maturing winter rice ("aghani" or "aman") can be grown or double cropping practiced. The middle terraces, used for both winter and autumn rice, rate second, and of least value are the highest terraces, which are almost invariably used for early-maturing, autumn-harvested rice ("bhadoi" or "aus") and which in seasons of low rainfall are apt to fail. In contrast, the criterion for assessment in the upland village, or in upland holdings of the valley village, is distance from the homestead. The most highly valued land is the fenced "bari," or garden, plot close at hand, which receives the manure of the cowsheds, house refuse, ashes, and tank silt; it is used to grow a summer food crop of maize and in the cold season, if water is available, rape and vegetables. Next in value is the "marua bari," unfenced but manured for the cultivation of pulse, poor

upland rice, and millet. Still farther away is the "tanr," the upland where the village animals are grazed and crops are grown in rotation sections about once in five years.²⁴

But whether upland or valley, the jungle played, and in some areas still plays, an important role in village economy. Dire famine is rare. Not only are there the fruits, such as the mango and jack, but in times of crop failure whole villages have been known to subsist on the amazing flowers of the mahua tree (*Bassia latifolia*). The yield of these flowers is dependent on dry weather from mid-March to mid-April, while the buds are maturing. The flowers are gathered by the villagers, dried for food, and used to make a popular country intoxicant; the seeds are pressed for oil. The jungle furnishes more than food. In addition to their valuable timber, the sal tree yields a bark that is used for tanning and the simal tree large pods that contain cottonlike fibers. Then there are the oils—mustard, linseed, gingili, and castor oil—the sugary sap of the khajur, and various gums, dyes, and resins. One of the most interesting of the resins is lac, a secretion incrusting the bodies of colonies of the lac insect, which lives on the sap of various trees, such as the palas. Originally the collection of lac was a haphazard though important subsidiary occupation, but with the growing stringency of market conditions collection has been largely replaced by cultivation; selected colonies of insects are "sown" on selected trees, and the product is harvested and marketed as stick-lac. The tall sabai grass, formerly gathered wild, is now often cultivated on the deforested slopes of the eastern hills for export to the paper mills of Hooghlyside; it is being displaced, however, by that other jungle grass, bamboo. Add to all of these the game—deer, wild pig, and other creatures of interest only to an omnivorous aborigine—and the use of the open forests as communal grazing and browsing grounds, and one begins to realize the great significance of the forest to the village economy. In many areas, however, the days of the forest frontier are past, and even, for example, in Hazaribagh District, where 2½ million acres out of a total area of 4½ million acres are still under forest, many of its villagers know the primeval jungle only in sacred village groves.

Many of the areas of primary settlement in the upper basin present the appearance and problems of the longer-settled agricultural countryside of the lower basin. Growing village populations are dependent on the resources of fragmented holdings of gneissic soils, rich in potash but deficient in lime

²⁴ An interesting comparison can be drawn here with the "infield" and "outfield" system of farming in parts of medieval Britain; for example, the cultivation of "brakes" on the Norfolk chalklands and the method of plowing the "outfield" of the Celtic Highland zone.

TABLE I—CROP ACREAGES IN THE LOWER DAMODAR DISTRICTS AND HAZARIBAGH*

DISTRICT	RICE				OTHER FOOD CROPS ^a	OILSEEDS ^b	SUGAR	FIBERS ^c	FRUITS AND VEGETABLES	AREA CROPPED ^d	
	"Aus"	"Aman"	"Boro"	Total						Total	Net
Burdwan	170,900	657,100	300	828,300	29,800	19,500	13,600	12,800	23,400	932,400	770,400
Bankura	278,200	440,000	500	718,700	35,500	23,800	3,600	2,200	13,300	803,900	753,900
Hooghly	35,000	411,800	2,000	448,800	33,200	3,200	20,400	33,300	18,000	574,100	534,000
Howrah	8,900	196,000	12,000	216,900	34,900 ^e	1,000	3,900	13,200	16,600	289,200	259,200
Hazaribagh ^f	345,000	146,000	—	491,000	401,700	119,200	9,600	800 ^g	1,000	1,030,100	949,000

* *Annual Season and Crop Reports*, Bengal Agricultural Department, Alipore; *Annual Season and Crop Report of Bihar 1945-1946*, Patna, 1948.

^aPulses, maize, barley, gram, millets, wheat

^bLinseed, till, rape, and mustard.

^cJute, sunn hemp.

^dThe total area includes acreages in minor crops. The difference between total area and net area is the acreage under double (or triple) cropping.

^eMainly pulses.

^f1945-1946.

^gCotton

and phosphates and in the humus the original forest cover provided. In spite of some excellent contour terracing, deforestation and overgrazing of poorly grassed hill slopes have accelerated soil erosion; in places, when the thin lateritic crust has been broken, huge gullies have laid bare the gneissic floor. Runoff is increased, the seasonal suddenness of rainfall is intensified, and rice cultivation throughout the basin is threatened by the creeping paralysis of sand. Thus in the pioneer fringe large tracts have developed the symptoms of overpopulation, including the movement out from the villages in search of work.

Except for the relatively modern deforestation of the jungle mahals in the western part, the lower basin is a region of anciently established rice cultivation. It is a landscape of nucleated villages, built on naturally or artificially dry sites in a web of bandhs and ditches that divide the village lands into an intricate patchwork quilt of paddy fields. The range of potential crops is similar to that in the uplands, but the crops grown reflect the changed hydrographic character of the lower basin. Table I gives the acreages normally occupied by the main crops in the districts of the lower Damodar and the 1945-1946 acreage in Hazaribagh District of the upper basin.

Certain features may be noted. Whereas the dominant rice crop in Hazaribagh is that harvested in the autumn, in the lower districts winter rice takes first place and summer rice ("boro") acreages are larger—a direct response to the longer availability of water, both surface and underground. Instead of the variety of crops grown in the upper basin, there is an absolute dependence on rice culture and increased double cropping. In Hazaribagh the 81,100 acres that bore more than one crop were in the lower terrace and "bari" lands alone; in the densely populated lower basin double and even triple cropping is widespread. In eastern Burdwan, for example, the land immediately surrounding the villages is planted to autumn rice, fol-

lowed by spring crops such as pulses and oil seeds, and the low-lying fields between the villages are usually devoted to winter rice, often followed by vegetables. Waste land is limited to grassed road and railway embankments, paddy bandhs, or the borders of some swampy "bhil." Population pressure has resulted not in the extension of agriculture into new areas but in the continued fragmentation of holdings under Hindu inheritance laws and in more intensive cropping. These in turn have led to a reduction of the margin between success and failure; many farmers are drifting away from the land to the slums of Calcutta and Hooghlyside, and those who remain in the villages are exposed to the diseases associated with stagnant water and to the perils of sand-spreading floods.

MINING AND INDUSTRY

Upon this old pattern of rural settlement has been superimposed a modern cultural landscape expressed in the chimneys and headgear of collieries, flooded quarries, pit heaps, the flat-roofed bungalows of managers, squalid "dhauras" of miners, straggling villages, clustered bazaars, railway sidings, and sprawling industrial towns. Of the coal-bearing Gondwana basins shown in Figure 3, Jharia has been the chief all-India producer since 1905. Some 175 square miles of Lower Gondwana sedimentary rocks have been preserved within the trough-faulted basin (Fig. 7). The series attains a thickness in any accumulated section of about 6800 feet, of which the argillaceous sandstones, buff-colored clays, and green shales of the lowest 800 feet, the Talchir group (Upper Carboniferous), and the 2080 feet of sandstones and shales of the Barren Measures do not yield coal. The main coal seams, some as much as 100 feet thick and of laminated appearance, occur interstratified with carbonaceous shales and sandstones in the 2000-foot Barakar series (Middle Permian) and the 1840-foot Raniganj series (Upper Permian). The main factor in the structure of the field is, as is usual in the Damodar coal fields, the great south boundary fault. The downthrow to the north of some 5000 feet has let down the Gondwana rocks into an asymmetrical syncline with an axis parallel to, and slightly north of, the fault, to be further broken by "sag" and cross faulting and penetrated by intrusive igneous dikes that are probably of the same age as the Rajmahal traps. These dikes and sills of mica peridotite and dolerite have burnt out the coal in some parts of the field and produced a natural coke known locally as "jhama." But in the northern part of the field some of the finest coking coals in India are easily accessible from the surface. The main collieries are concentrated on the exposed portion of these Barakar beds, taking advantage of the gentle south-

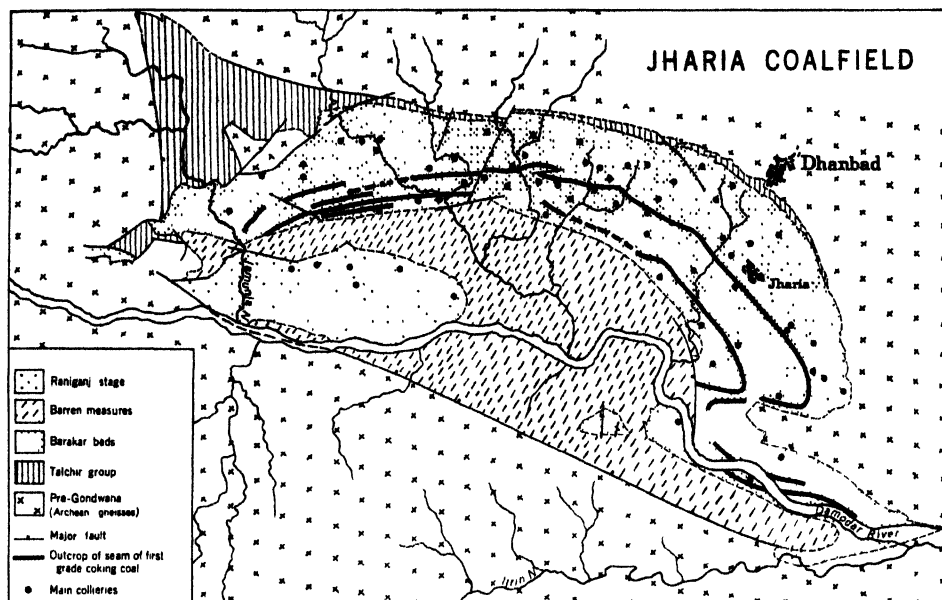


FIG. 7.—Most productive of all Indian coal fields, the Jharia accounts for 40 per cent of total output.

ward dip and the valleys of the south-flowing streams. The coals of the Barakar series are nearly all of the low-volatile type; they are infinitely superior to the high-volatile Raniganj coals, and much greater in quantity. In general, in the rift zone, the Barakar seams tend to weaken eastward and the Raniganj seams to thin out westward.

The coal has been worked by various methods, including inclines, small quarries, and huge opencast workings, the hand hewing of long walls and electric coal cutters on short walls (as at the Jamadoba colliery of the Tata Iron and Steel Company). In the absence of firedamp, lighting presents no great difficulties. In the early collieries on the valley sides drainage was never a serious problem, but as the mines have gone deeper, difficulties have arisen. Water-bearing sandstones increase working costs; in many of the older deserted mines incomplete coal barriers hold back the water from the more recent mining "down the dip"; the depillaring of old seams has resulted in surface subsidence. Increasing attention has been given to the possibility of the sand stowage of voids. As it takes some four tons of sand to stow efficiently the void left by the extraction of one ton of coal during depillaring of old workings, and a ton for a ton in newer ones, the relation between this problem and the flood sand of the Damodar River is evident. But perhaps the greatest task of all is to ensure that the wasteful exploitation of the past, which has sterilized a great deal of valuable coal and removed

the better-grade, easily accessible coals regardless of their ultimate use, is replaced by a policy of conservation. Dr. C. S. Fox²⁵ has estimated that of the total reserves of coal in the field, namely 1707 million tons, 3122 million tons, and 4237 million tons at 500 feet, 1000 feet, and 2000 feet respectively, there are only 408 million tons, 793 million tons, and 956 million tons of first-grade coals available. At the present rate of extraction and waste (in some cases 50 per cent of total) the finest coking coals in India will have disappeared to a depth of 1000 feet in 40-50 years.

The Jharia field, though ranking first in production, was not the first Damodar field to be worked; the economic development of the coal fields is closely associated with the westward extension of railways from Hooghly-side. The earliest record of commercial interest in the coal resources of the valley is a grant of coal mines to Messrs. Sumner and Heatley in 1774, which was followed three years later by a request from Messrs. Motte and Farquhar that they be allowed to cast shot and shell in the pargana of "Jerriah":

We are of the opinion, that the pergunna called Jerriah, lying between the Rivers Dum-mooda and Barraker in the province of Pachete is the fittest situation for the iron works. The River Dum-mooda is navigable as high as that place. It abounds with iron ores, and has the singular advantage of being contiguous to the coal mines of which Sumner and Heatley have a grant.²⁶

The "pergunna called Jerriah" was in all probability the western part of the Raniganj field, since when Hughes made his survey of the Jharia field in 1865-1866 he found no evidence of mining; in fact, the true development of mining at Jharia did not come until after the arrival of branch lines of both the East India and Bengal-Nagpur Railways in the 1890's. The Raniganj field, being nearer to Hooghlyside, was reached by the railway almost 40 years earlier (1855)—a factor that has given special direction to its economic development.

It is interesting to note how Motte and Farquhar's opinion regarding the potential value of the Raniganj field as a site for the location of industry other than mining was later justified, though by factors of which they had no knowledge. The iron ores they mention as "abounding" in the area were principally clay ironstones of the middle Damodar Ironstone Shales,²⁷ and these ores remained a constant promise to geological surveyors throughout the nineteenth century. T. W. H. Hughes, for example, in a "Note on the Raw Materials for Iron Smelting in the Raniganj Field"²⁸ in 1874 calculated

²⁵ C. S. Fox: *The Jharia Coalfield, Memoirs Geol. Survey of India*, Vol. 56, 1930.

²⁶ *Ibid.*, p. 1 (quoted).

²⁷ The stratigraphic equivalent of the Barren Measures of the Jharia coal field.

²⁸ *Records Geol. Survey of India*, Vol. 7, Part 1, 1874, pp. 20-30.

that 200 million tons of ore was available to a square mile of ironstone shale outcrop. Indeed, the Barakar Ironworks of the Bengal Iron and Steel Company were located at Kulti to utilize this close association of clay ironstone and coking coal, but it was found that the oxidized ironstones occurred only at the surface and gave way at shallow depths to less valuable sideritic bands. Nevertheless, the company did mine the weathered ores at a rate of about 7000 tons a year until 1914, when new sources of high-quality ore were developed. In view of the immense reserves of high-grade hematite ores within short rail distance of the Damodar Basin in Singhbhum District (Fig. 3), it is doubtful whether the Ironstone Shales will again prove of economic value. Limestone, also, though found in the lower Panchet strata to the west of Panchet Hill and in the lime nodules known as "kankar," is too irregular and widespread in distribution to be economically worked.

It was the extension of the railways that broke down the prejudice of the Calcutta buyer against Indian coal, made coal mining less risky financially, and not only provided a large market for coal in the railways themselves but made possible the assembly of the raw materials of industry.

Railway junctions such as Asansol grew up and developed industrial suburbs. The blast furnaces and coking ovens at Kulti and Burnpur with their associated engineering works, the railway workshops at Andal, the production of broad-gauge railway wagons at Hiraipur, the brickyards at Raniganj, and the building of several thermal power stations²⁹ in the valley are only a few of the examples of industrial growth within the past 50 years.

This development of industrial centers is not characteristic of the Damodar coal fields in general, and the settlement pattern of the western fields, which were not reached by the railways until later, can be compared with that of the British coal fields in the eighteenth century before the emergence of the specialized mining village. The greater part of the labor force of the collieries is drawn from the surrounding countryside; the workers live in their own agricultural villages and regard employment in

²⁹ Thermal electricity production of the Damodar Valley, 1947 (power stations over 1000 kilowatts; projected capacity is additional).

COAL FIELD	STATIONS	CAPACITY	
		PRESENT	PROJECTED
Raniganj	10	75,075	21,500
Jharia	8	43,975	84,000
Giridih	1	4,650	2,500
Bokaro	1	4,500	150,000 (Bermo)
S. Karanpura	1	2,000	—
Ramgarh	1	1,600	—
Total	22	131,800	258,000

the mines as a means of supplementing their incomes during the slack periods of the agricultural year. The main result has been an increase in the density of rural settlement by a widening of the base of employment. But some of the workers come from much farther away; many of the Santals, for example, consider employment in the mines a lucrative alternative to seasonal labor on the Assam tea plantations. To house and feed such workers, hutted camps and adjacent bazaars have sprung up near the mines. A large number of these camps are squalid affairs, breeding grounds for disease, and in pursuance of a policy of maintaining a permanent and healthy labor force many mining companies are attempting to improve the camps by providing a good water supply, adequate sanitation, and better shopping facilities.

The development of mining has had other effects on the old pattern of settlement. Towns such as Pachamba, administrative headquarters of north-eastern Hazaribagh and a busy trade center on the old road to Nawada, have declined in importance as new administrative and trading communities have grown up near the railways. The old city of Jharia, with its early burial mounds, ruins, and ancient tanks, has yielded precedence to Dhanbad, which grew up at the junction of the colliery branch lines with the Grand Chord line. A further example of economic reorientation is the decline in the trade hinterland of Chatra, beyond the western watershed. When the railhead in the upper valley was Barakar, Chatra drew the trade of the plateaus to its bazaars and its great November cattle fair, but the movement of the railhead progressively westward during the early years of this century reduced Chatra's sphere of influence, and the building of the Karanpura Valley line has still further restricted its commercial activities.

Thus the old patterns of human occupation in the Damodar Basin have given way to new, and, inevitably, new problems have arisen. Soil erosion and silting, floods and stagnant waters, are local and regional problems resulting from physical change and must be solved by further physical change. Conservation and the efficient development of natural resources are national problems resulting from economic and human change and must be solved by the creation of new standards. The Damodar Valley Project attempts to solve both groups of problems and therefore must work in two fields.

THE DAMODAR VALLEY PROJECT

The main physical features of the project are shown in Figure 8. The nature of the river is to be changed—the gradient in the upper basin, the direction of discharge in the lower, and the regime throughout. Seven great dams are to be built in the upper basin, with the dual function of evening

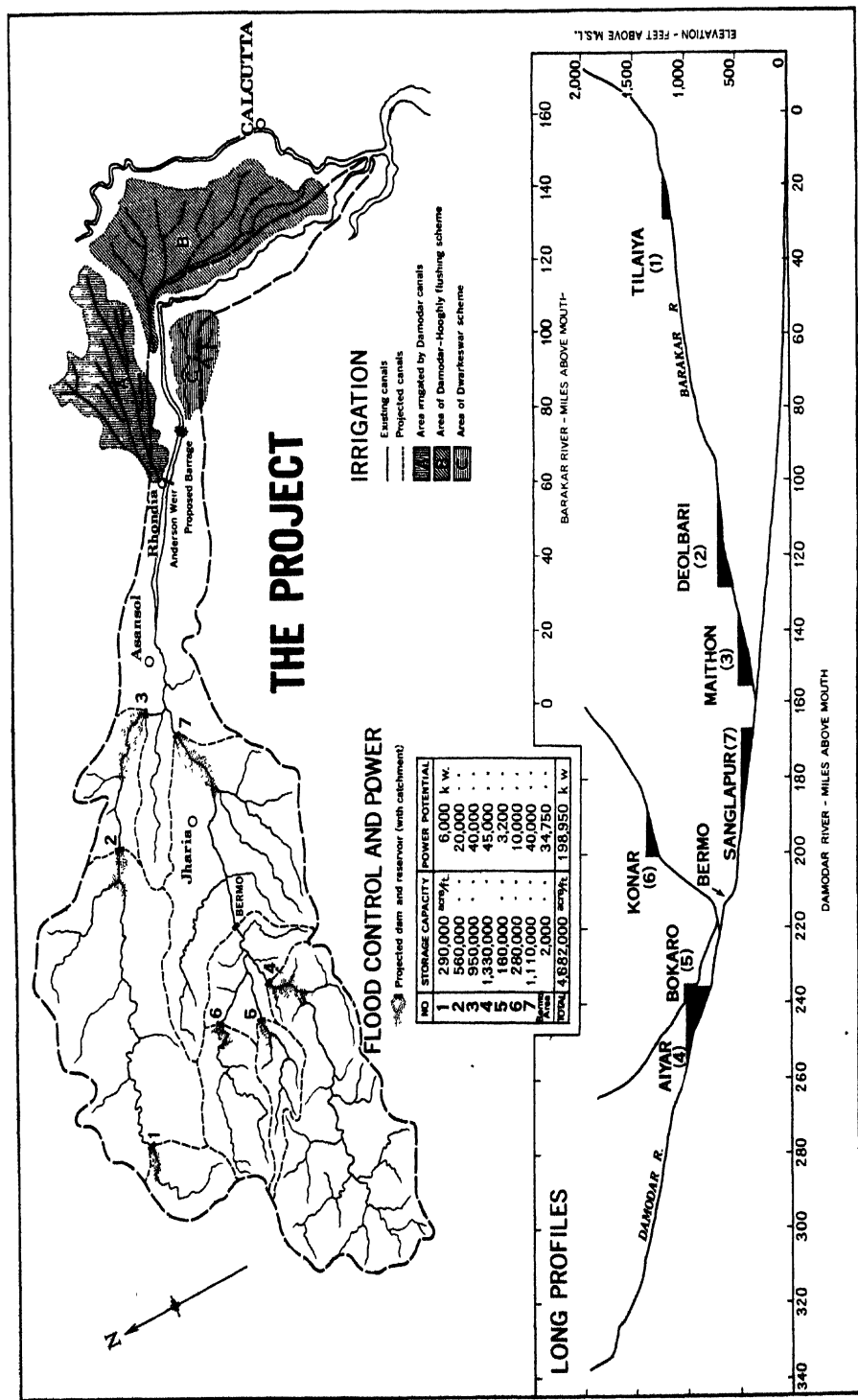


Fig. 8—The Damodar Valley Project. When the seven proposed dams are completed, 175 square miles of land will be submerged, but nearly 10,000 square miles will benefit.

the regime of the river and creating breaks of slope for the generation of power. The siting of these dams demands a careful balancing of geographical factors. To protect the lower basin against floods, they must be of a size and reservoir capacity adequate to meet the severest possibilities conceivable; for example, a storm rainfall such as that shown in Figure 4 but centered over the Hazaribagh plateau, producing an average rainfall of 20 inches, with a runoff coefficient of 90 per cent and peak flows of as much as a million cusecs. To gain such reservoir capacity without submerging vast tracts of country, an upstream site with a reasonable valley gradient is necessary. On the other hand, if the key dams are too far upstream, an area large enough to be liable to flooding in itself may be exposed downstream. The topography below Asansol rules out sites below the confluence of the Damodar and the Barakar, but to maintain control as far downstream as possible, the engineers have advised the construction of dams in the vicinity of Maithon Hill on the Barakar and Panchet Hill (Sanglapur) on the Damodar, both a few miles upstream of the confluence. More than 1500 square miles would be left uncontrolled, but fortunately the configuration of the basin below these points is not conducive to floods. This siting also limits the size of the lower key reservoirs and necessitates a series of dams higher upstream.

The choice of locations reflects other factors. It is necessary to avoid submerging the exposed coal fields and thus sterilizing the coal. There is also the necessity of ensuring sound foundations both for the dams and for the reservoirs; in 1920 a project for the construction of a dam near the mouth of the Parjuria River had to be abandoned because, although the dam itself was clear of the south boundary fault, the 40 feet of water the engineers wished to hold above it would have filtered down the fault plane into the coarse sandstones and caused serious difficulties in the deepest workings of the Bhatdih and Murulidih collieries of the Jharia coal field. As the generation of electricity is a secondary function of the dams, the advantage of utilizing natural breaks of slope is obvious.

The upper basin, in Bihar, will benefit from the projected reservoirs in assured water supply, electricity, and the fishing and recreational facilities they will provide, but of course the main benefits will accrue to the lower basin, in Bengal. Here not only will excessive floods be prevented but a steady flow of fresh irrigating water will be available throughout the year. Today some 186,000 acres receive a highly uncertain supply of water from the Eden and Damodar Canals. The Eden Canal was constructed in 1873 as a sanitary work but soon came to serve as an irrigation canal for 25,000 acres. Some 161,000 acres more were brought under irrigation by the con-

struction of the Damodar Canal from Anderson Weir in 1926-1933. These canals dry up during the period November to May, and often the flow is insufficient for the last watering of the paddy in October; in about one year in five they fail even in the wet season. Regulation of flow by the proposed works in the upper basin will ensure a permanent supply in these canals and facilitate their extension. In addition, a new barrage will furnish water to canals on both banks of the river: to the north a main distributary will enable the realization of the Damodar-Hooghly Flushing Scheme adopted by the Bengal government in 1939; to the south a second system will carry water to the Dwarkeswar area (Fig. 8). Nearly one million acres in all will be irrigated, and the evils consequent on the change of course of the lower Damodar will thus be partly remedied. There is also a possibility that the Damodar River can provide a navigable channel between the coal fields and the Hooghly. In itself this would not be economically desirable, but as part of a multipurpose project it would be worth while. With a regular flow of 4000 cusecs in the lower river and the depth above Burdwan increased by an irrigation barrage, boats of five feet draft might carry bulk goods between Calcutta and the Raniganj coal field.

These physical changes are not without their dangers and problems. The criticism that the silt load of the Damodar is so heavy that reservoir capacities will soon be greatly reduced can be in part refuted by pointing out the possible use of the reservoir sediments for sand stowage in the collieries and the proposals for large-scale afforestation and other soil-conservation measures in the upper basin. The criticism that the high hopes for enormously increased crops in the lower plains disregard the limitations of soil that, though watered, lacks annual fertilization may be in part answered by saying that cheap electrical power will mean cheap artificial fertilizers and remove the necessity of burning cow dung as fuel. And to the criticism that power could be more efficiently produced by increasing the number of thermal power plants on the existing valley grid the reply may be that the great need is to conserve coal. But all these answers rest on the human factor, especially a changed attitude toward land utilization, for which also the Damodar Valley Corporation must be held responsible. Will the upland cultivator occupying land won from the jungle by his pioneer ancestors be persuaded that in the interest of national and regional economy the land should revert to forest and that he would be better off employed in an aluminum plant? Will the lowland cultivator throw off the apathy resulting from life in an overpopulated area and be persuaded that he can best serve the nation by becoming an efficient farmer living in a model village powered

by electricity, instead of drifting to the slum fringe of the Calcutta conurbation?

The Damodar Valley Project is much more than an engineering scheme, and one of the dangers the corporation must guard against is preoccupation with financial balances and material change, important though these may be, to such an extent that it loses sight of the deeper human significance. India can show many magnificent engineering achievements that were projected from without, but this is the first that has been projected from within, and in the long run its success will depend on the full support and cooperation of the people and be judged by the change in human standards it accomplishes. This is also the first time in the history of the young Indian nation that the resources of a river have been "envisioned in their entirety." Hughes in his survey of the Jharia coal field referred to the Damodar Basin as the "valles opima" of Bengal;³⁰ it is rapidly becoming the "valles opima" of India, the valley of the great experiment, the fruits of which will influence the course of Indian geography. For if sectional and local interests are overcome here in the attempt to organize a natural region for the maximum good of its peoples, this will help shape a similar approach to larger regions. And thus a concept reborn into the modern world in the Tennessee Valley returns to a continent where civilized life began with the organization of river basins. The wheel has come full circle.

³⁰ Theodore [W. H.] Hughes: The Jherria Coal-field, *Memoirs Geol. Survey of India*, Vol. 5, 1866, pp. 227-336; reference on p. 227

THE RELIEF CONTOUR METHOD OF REPRESENTING TOPOGRAPHY ON MAPS

KITIRÔ TANAKA

MOST maps showing relief by hill shading are ineffective because the treatment of light and shade is not accurate. The eye is acutely sensitive to differences in brightness; therefore the more minute and exact the representation of these differences is, the stronger will be the relief effect. Thus a photograph of an accurately constructed relief model that has been obliquely illuminated usually gives a strong impression of relief.

The method of hill shading described and illustrated in this article was developed by the author¹ to give to a contour map the appearance of detailed relief while preserving the essential character of the contours.²

The method is based on a theory concerning the configuration of brightness on a surface obliquely illuminated. This theory enables a numerical value of the brightness at any point on the surface to be calculated. The method can best be understood with reference to Figures 1 and 2. Figure 1 shows a hill having a spherical surface represented according to the principle of an ordinary contour map. A is a profile, and B is a plan; 1 is the horizontal datum plane, and 2 indicates contours. Figure 2 shows the same hill represented by the proposed method. Numeral 3 is the direction of the source of the illumination inclined at an angle of 45° to the horizontal; 4 is the horizontal direction of dip or slope; θ is the horizontal angle between 3 and 4; 5 is the background of the map shown in a medium tone; 6 indicates contours drawn in white representing slopes having a θ angle of less than 90° ; 7 indicates contours drawn in black representing slopes having a θ angle of more than 90° . The thickness of the contour lines varies with the cosine of θ . In other words, if t is the thickness of a contour line at any point on the map, and t_0 is the maximum thickness, then

$$t = t_0 \cos \theta. \quad (1)$$

The thickness will therefore be greatest when θ is 0° or 180° . When θ is

¹ The author acknowledges with gratitude his indebtedness to the Imperial Academy, Tôsyôgû Memorial Society, Japan Society for the Promotion of Researches, and the Scientific Research Fund of the Ministry of Education for their grant in expenditures.

² Another method, the "Orthographical Relief Method," was previously proposed by the author (*Memoirs College of Engineering, Kyûsyû Imperial Univ.*, Vol. 5, No. 3, 1930, pp. 121-143 [in English]); see also Kitirô Tanaka: The Orthographical Relief Method of Representing Hill Features on a Topographical Map, *Geogr. Journ.*, Vol. 79, 1932, pp. 213-219).

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90°, the thickness of the contour lines is negligible. Contour lines drawn in this way may be called "relief contours."

The choice of the maximum thickness for the relief contours is somewhat arbitrary, depending to a certain extent on the exaggeration or reduction of the relief effect required.

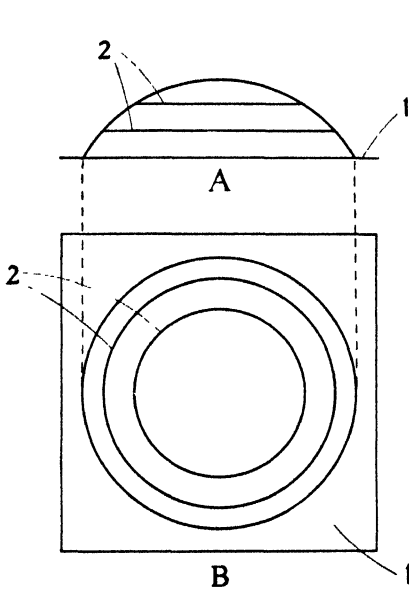


FIG. 1

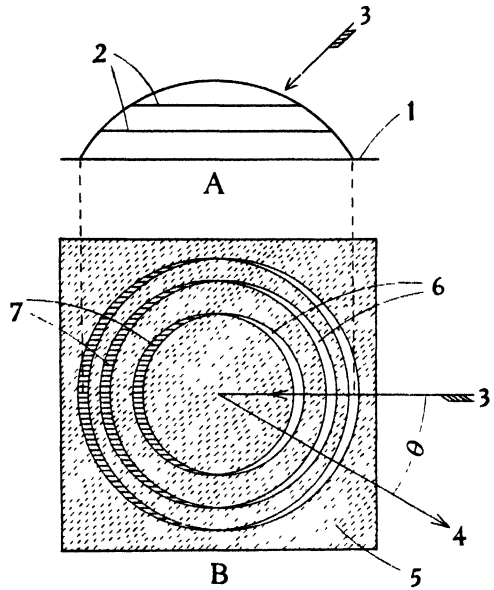


FIG. 2

Let the scale equivalent of the vertical interval be d_o and let γ be the dip angle of a small or elementary area of constant slope, then d , the horizontal spacing of the contours representing this slope, can be expressed by

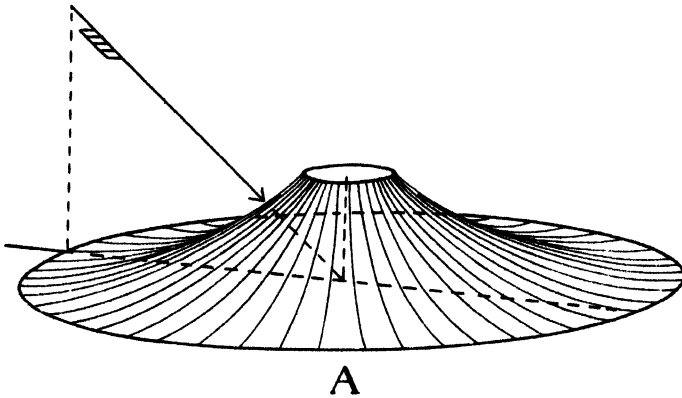
$$d = d_o \cot \gamma. \quad (2)$$

In the method being described,

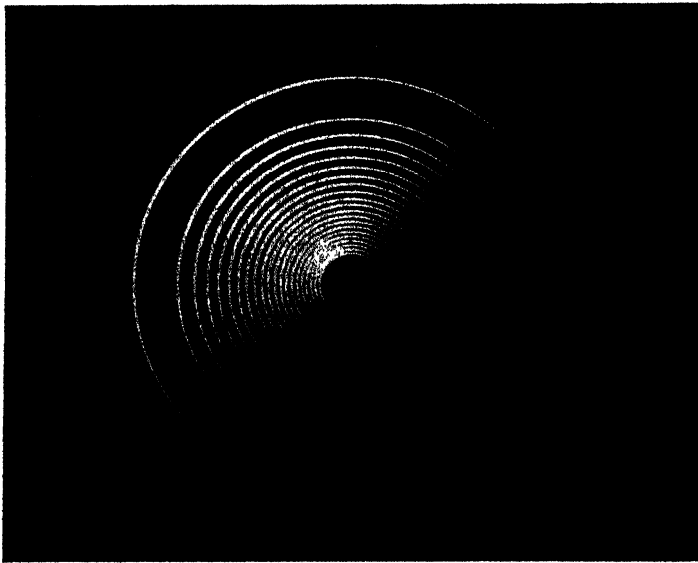
$$t_o = k d_o, \quad (3)$$

where k is a constant referred to as the "line factor."

Regardless of the best value for k (to be discussed later in this article), it should be obvious that when t equals d , the relief contour lines will merge. Hence from equations 1, 2, and 3, this situation will begin when $\cot \gamma$ equals $k \cos \theta$ regardless of the vertical contour interval. For example, if k equals 1 and θ is 0° or 180°, the relief contour lines will merge for all slopes in these directions greater than 45°, and when k equals 1 and θ is 60° or 120°, merging takes place when the dip angle becomes 63½°. However, as will now be



A



B

FIG. 3

demonstrated, this limitation of the method is not as a rule serious for most types of topography.

THE EFFECTIVENESS OF THE METHOD

Figure 3A shows a symmetrical solid somewhat resembling a volcanic cone in perspective, and Figure 3B the same solid by relief contours. It will be observed that 3B resembles a vertical photograph of a relief model made by placing cardboard layers one above the other.³ Figure 4 consists of two

³ According to Raisz (Erwin Raisz: *General Cartography*, New York and London, 1938, Fig. 90 [on p. 145]), a somewhat similar method but without the present method's refinement in theory and practice was published by the British Ordnance Survey in 1866.

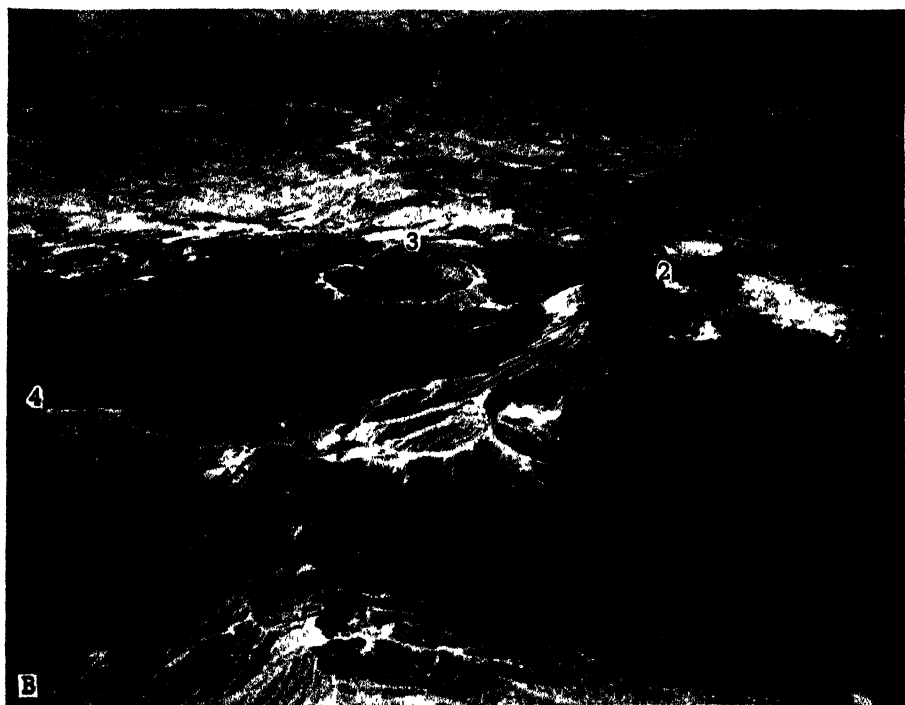


FIG. 4

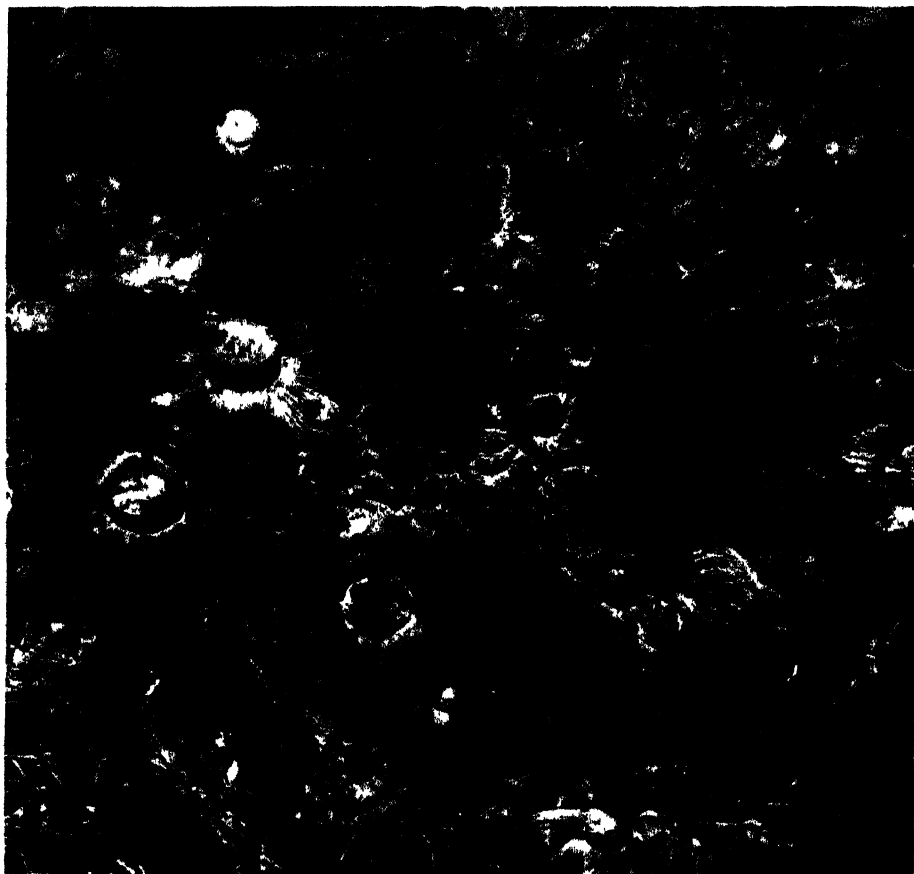


FIG. 5

oblique photographs taken by the author of the Kirishima volcano group near Kagoshima in Kyushu, Japan. The topography can be easily visualized. It is of physiographical interest that the volcanic cone numbered 4, the Sinmoe-dake, which means literally "a newly burned peak," is the latest eruption. It is therefore, as the photographs clearly show, very little dissected as compared with the older cones 2 and 3. Cone 5 is the oldest eruption and thus is maturely dissected. Figure 5 is a mosaic of vertical photographs, taken from an altitude of 5000 meters, of this same group of volcanoes, the highest points of which are more than 1000 meters above the surrounding lowlands. Contrary to what one might expect, the mosaic does not present an easily interpreted relief effect. Figure 6 is part of an official Japanese government topographical sheet, showing the same volcanic group by means of 20-meter contours. Figure 7, which illustrates the method being described,

is based on the map shown in Figure 6. Note that without destroying the minute and quantitative representation characteristic of the original contour map the relief perception by means of relief contours is greatly enhanced. For example, the physiographic features mentioned above are now strikingly apparent.

METHODS OF DRAWING AND REPRODUCTION

One may reasonably doubt whether such seemingly complicated contour lines can be easily and quickly drawn. A simple and exact method is available, however, that can be satisfactorily used even by an untrained person after a little practice. If the tip of a drawing pen, 8 in Figure 8, is filed down so that its thickness is the maximum thickness required in a contour line, and if, as in *Rundschrift* lettering, the pen-point edge is kept at a fixed orientation, 3, in this case parallel to the assumed horizontal direction of the incident light, then the thickness of the contour line will vary with the cosine of the angle θ .

An original monochrome drawing of a map such as is shown in Figure 7 can of course be reproduced by half-tone or gravure methods. The author, however, recommends another method, which eliminates the use of a screen and thereby gives a sharper effect to the line detail. In this method at least two printing plates are used, one for the neutral background on which the light contours will be represented by the untouched surface of the paper, and the second for the dark contours and any other detail required. Additional printing plates can be easily prepared if it is desired to print this other detail in different colors. As will be made clear later, a further advantage of using at least two plates is that the relative brightness effects can be more easily regulated, since the background and the dark relief contours are printed separately.

The recommended procedure is as follows: (1) Spray with an airbrush a water color in Prussian blue or ultramarine over the drawing paper on which the map is to be finally drawn. (2) Transfer onto the paper the monochrome base-map compilation, including ordinary contours, drainage, roads, cities, symbols, and lettering. (3) Ink in the dark relief contours in black, and also all other detail except the light relief contours. (4) Ink in the light relief contours in poster white. (5) Make a negative of this drawing on a panchromatic plate, using a red filter, so that the light contours appear as black lines and all other detail, including the background tint, vanishes in transparency. This negative is used to prepare the printing plate for the background and the light contour lines. (6) Make another negative on a panchromatic plate, using a blue filter, so that all detail except the light contours appears as





FIG. 7

To determine the brightness of the map, we may consider a quadrilateral of constant slope on a section of the map on which light relief contours appear (Fig. 10). Now since the brightness of a surface is equal to the intensity of the emitted flux, the mean brightness b of this elementary quadrilateral can be obtained by dividing the total emitted flux by the area. Hence,

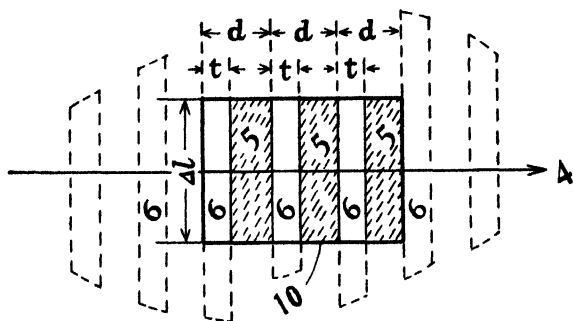


FIG. 10

if K is a constant concerning the intensity of the incident ray, n is the number of relief contour lines contained in the area, and Δl is the elementary length of these lines,

$$b = K[\rho_0 n (d - t) \Delta l + \rho n t \Delta l] / n d \Delta l$$

or

$$b = K[\rho_0 d + (\rho - \rho_0)t] / d.$$

Now substituting for d and t from equations 1, 2, and 3,

$$b = K[\rho_0 + k(\rho - \rho_0) \cos \theta \tan \gamma]$$

or

$$b = K \sec \gamma [\rho_0 \cos \gamma + k(\rho - \rho_0) \sin \gamma \cos \theta].$$

Now b should reach its maximum value when the slope is perpendicular to the presumed direction of the incident light. So in the comparison being made the maximum brightness is obtained when θ is 0° and γ is 45° . Thus

$$b_{max} = K[\rho_0 + k(\rho - \rho_0)].$$

The ratio $b:b_{max}$ is the relative brightness B_m of the elementary surface on the map, so after substituting for k from equation 4,

$$B_m = \sec \gamma (\cos \gamma + \sin \gamma \cos \theta) / 2. \quad (7)$$

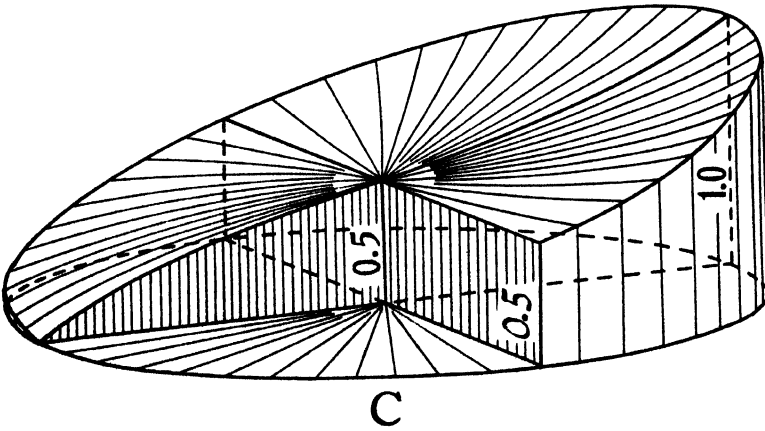
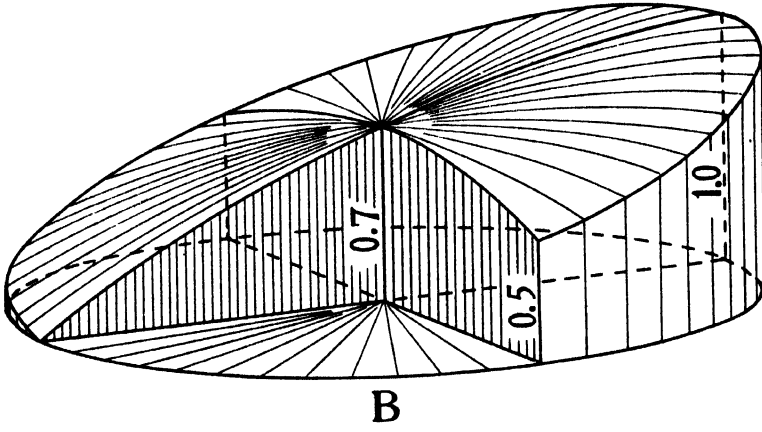
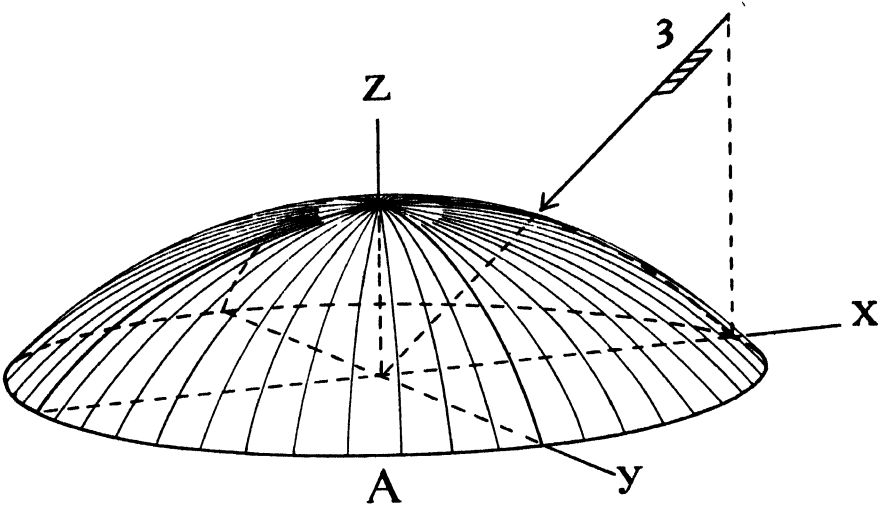


FIG. 11

The same reasoning is applicable to slopes having a θ angle of more than 90° , and, so far as we substitute the line factor k' for k , the relative brightness will be expressed by the same equation (7).

Now it will be observed from equations (6) and (7) that B_m is not identically equal to B . Thus if the relative error in the brightness of the map is denoted by E , then

$$E = 1 - (B_m/B) = 1 - (\sec \gamma / \sqrt{2}). \quad (8)$$

The error E is independent of θ , that is to say, independent of the horizontal direction of slope. This gives a desirable consistency to the map. The maximum value of E , if slopes greater than 45° are not considered, is when γ is 0° . This amounts to 29 per cent. The error decreases gradually to a zero value when γ is 45° .

These errors can be visualized in Figure 11. A is a spherical surface of which the dip is 45° at the base; B shows the theoretical relative brightness of this surface, and C the relative brightness of the map, the ordinates from the base plane representing the relative brightness in each case. Thus, though the proposed method does not afford an exact facsimile of the theoretical configuration of the brightness of an actual surface, there is a reasonably close resemblance.

NEW SEAMOUNT IN THE NORTH PACIFIC OCEAN

HAVEN NICHOLS

A NEW seamount, at a depth of 665 fathoms (Figs. 1 and 2), was recorded at $50^{\circ}10'N.$, $141^{\circ}59'W.$, some 400 nautical miles southwest of the Queen Charlotte Islands, on September 26, 1949, by the United States Coast and Geodetic Survey ship *Explorer*, Commander H. Arnold Karo. A "seamount" has been defined as a submarine mountain rising more than 500 fathoms (3000 feet) above the deep-sea floor.¹ A "guyot" is a seamount with a flattened top that is generally at depths of 500 to 900 fathoms.² The crest of the newly discovered feature is within the limiting depths of a guyot, but its profile as based on a single line of soundings does not indicate such a form of submarine relief (Fig. 3).

The track line of the *Explorer* is an interesting study in itself; for it presents a profile across the Gulf of Alaska and the North Pacific Ocean. A brief narrative description of this track line follows.

The track line began on September 21, 1949, in depths of 91 fathoms at latitude $51^{\circ}49'N.$, longitude $175^{\circ}45'W.$, near Adak Island, Alaska, and followed an approximate great-circle course to the vicinity of Yaquina Head, Oreg. A relatively sharp escarpment appeared at $52^{\circ}05'N.$, $171^{\circ}20'W.$, where the bottom sloped from 570 fathoms to 1040 fathoms in less than five miles. The depth then increased gradually to about 2000 fathoms at $52^{\circ}15'N.$, $168^{\circ}00'W.$, then rapidly to 3940 fathoms at $52^{\circ}23'N.$, $165^{\circ}53'W.$, in the Aleutian Trench, then decreased more slowly to 2500 fathoms at $52^{\circ}21'N.$, $161^{\circ}02'W.$ Thereafter, with only a few exceptions, depths were within 50 fathoms of 2500 to $51^{\circ}15'N.$, $148^{\circ}20'W.$ Except on the seamounts to be discussed later, the depth then decreased gradually and uniformly to 1400 fathoms at $45^{\circ}12'N.$, $125^{\circ}25'W.$, then sharply to only 45 fathoms at $44^{\circ}40'N.$, $124^{\circ}23'W.$, about 20 miles west of Yaquina Head.

¹ K. T. Adams: Hydrographic Manual, U. S. Coast and Geodetic Survey Special Publ. No. 143, revised edit., 1942, p. 54.

² H. H. Hess: Drowned Ancient Islands of the Pacific Basin, *Amer. Journ. of Sci.*, Vol. 244, 1946, pp. 772-791; reference on p. 772.

The following general references may be cited: Frederick Betz, Jr., and H. H. Hess: The Floor of the North Pacific Ocean, *Geogr. Rev.*, Vol. 32, 1942, pp. 99-116; H. W. Murray: Submarine Mountains in the Gulf of Alaska, *Bull. Geol. Soc. of America*, Vol. 52, 1941, pp. 333-362; *idem*: Profiles of the Aleutian Trench, *ibid.*, Vol. 56, 1945, pp. 757-781; F. P. Shepard: Submarine Geology, New York, 1948; F. P. Shepard and K. O. Emery: Submarine Topography off the California Coast: Canyons and Tectonic Interpretation, *Geol. Soc. of America Special Paper No. 31*, 1941.

► MR. NICHOLS is a cartographic engineer with the United States Coast and Geodetic Survey, Washington, D. C.

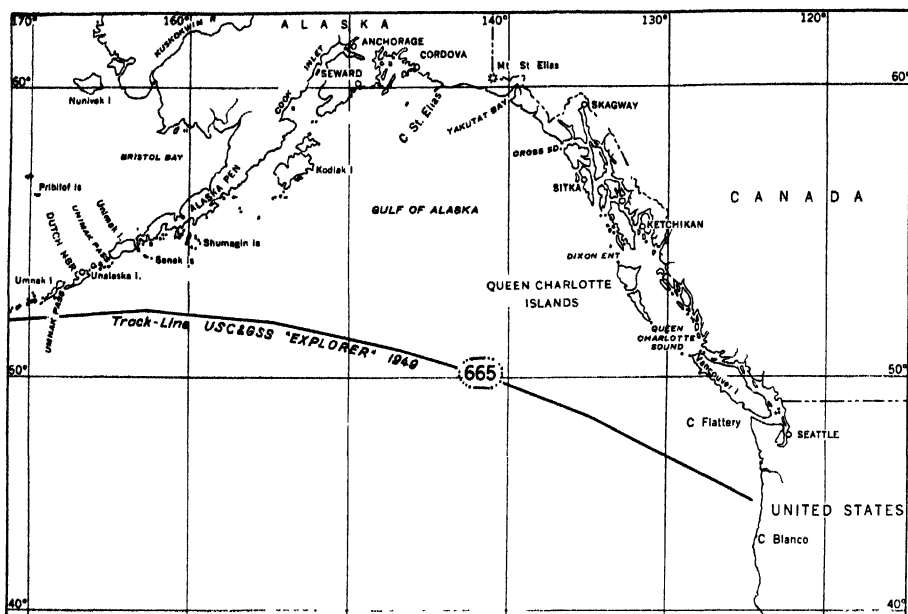


FIG. 1

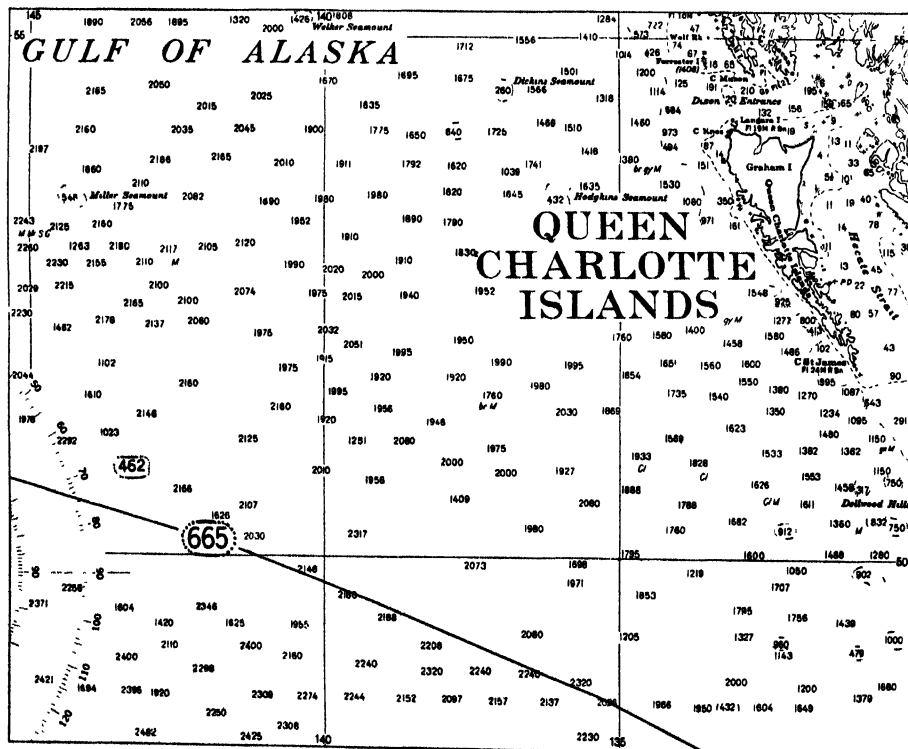


FIG. 2

SOUNDING METHODS AND CONTROL

Celestial sights supplemented by loran fixes were used for horizontal control for the greater part of the voyage and were sufficient to establish location accurately within three or four miles.

Depths were obtained with an NMC supersonic recorder, a navigational instrument that employs the magnetostrictive properties of nickel in its projectors to transform electrical energy into acoustical energy and vice versa. The recorder is calibrated for a sound speed of 800 fathoms a second in sea water. It has two projectors, one for shallow soundings (0-200 fathoms) and one for deep soundings (0-4000 fathoms). Each projector has a resonant frequency of 18 kilocycles and serves for both transmitting and receiving, either projector being placed in the circuit by a "range" switch. The mechanism speed is maintained close to its calibrated value by use of a special 60-cycle frequency in the circuit, which limits the error to 1 in 8000 or 9000 cycles.

The operation of the recorder is briefly explained here to account for the apparent loss of profile at the bottom edges of the fathograms (graphic records of sounded depths) in Figures 3, 4, and 5. The recording paper moves from top to bottom, with the zero on the left. When the range switch is set to read 0-2000 fathoms, the stylus, moving from left to right across the paper, records the depth by two marks: an initial mark or contact at the extreme left, which is the impulse sent to the bottom of the ocean, and another mark when the impulse is returned. When the stylus reaches the extreme right, another impulse is sent but is not recorded, since the stylus is electrically disconnected on all return strokes from right to left. When the range switch is set to read 2000-4000 fathoms, the initial mark or impulse is recorded on the extreme right; the return of the impulse is marked on the next stroke from left to right. The last recorded impulse, added to 2000 fathoms, is the desired sounding.

DESCRIPTION

The fathogram and a profile of the part of the *Explorer's* track line with which this paper is concerned are shown in Figure 3. Hourly fixes begin with position 127E, depth 2205 fathoms, at 3:00 a.m., September 26, and end with position 131E. The line continues 40 minutes beyond 131E, where the depth is also 2205 fathoms. Corrections to the nearest five fathoms have been applied for instrumental errors and the velocity of sound in sea water. Recorded depths on the seamount are believed to be accurate within 10

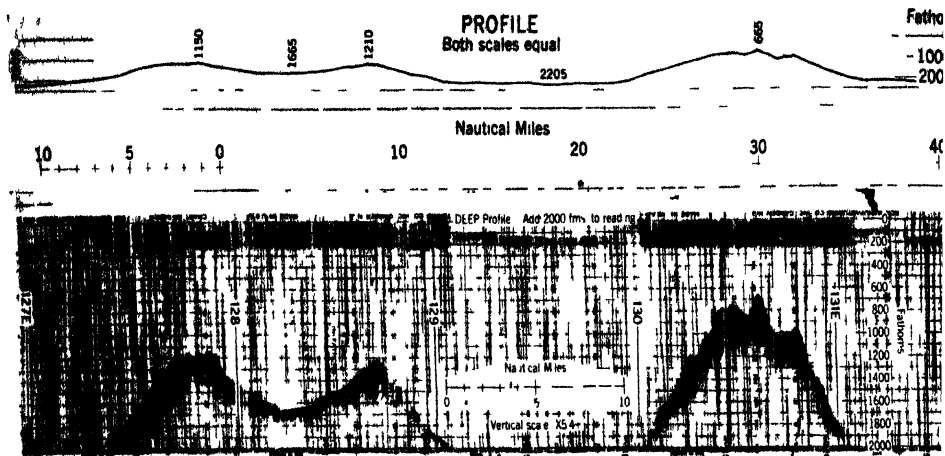


FIG 3—Fathogram and profile of *Explorer* September 26 1949

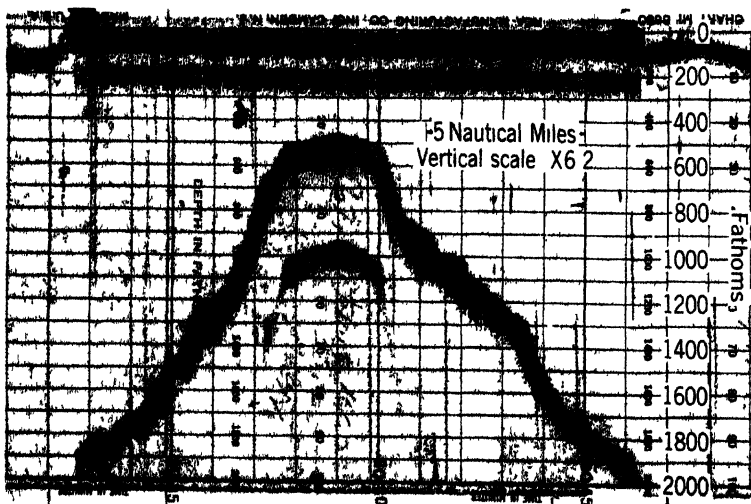


FIG 4—Fathogram of *Pathfinder* October 2 1947

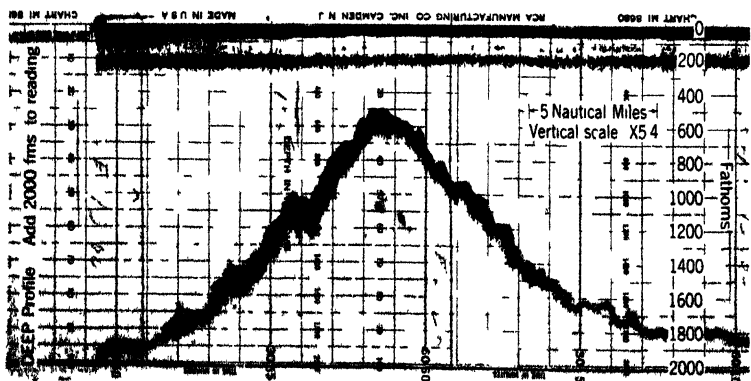


FIG 5—Fathogram of *Pathfinder*, September 21, 1949

fathoms. Two less pronounced seamounts can be noted on the fathogram between positions 127E and 129E.

On October 2, 1947, a seamount was discovered by the United States Coast and Geodetic Survey ship *Pathfinder*. The fathogram of this is shown in Figure 4; it lies about 60 miles northwest of the *Explorer's* seamount and is charted at a depth of 462 fathoms; its profile seems to be that of a guyot.

The fathogram of a seamount recorded on September 21, 1949, also by the *Pathfinder*, is shown in Figure 5. Its position, controlled by celestial sights and hourly loran line-of-position fixes, is at latitude $48^{\circ} 31' N.$, longitude $133^{\circ} 10' W.$ Its corrected least depth of 502 fathoms was recorded by an NMB-1 recorder, which operates and records similarly to the NMC. It plots on the plan map (Fig. 2) very near to the 432-fathom sounding at $48^{\circ} 32' N.$, $133^{\circ} 12' W.$ This latter sounding was recorded October 2, 1939, by the United States Coast and Geodetic Survey ship *Guide*. Its position was controlled by dead reckoning; the depth was recorded by a 312-J fathometer, a sonic, visual type that has no mechanism for recording a profile.

It should be noted that the character of submarine features in any given area usually has been determined only by a single track line; accurate correlation should not be attempted without further adequate data.

SAHARAN SAND DUNES AND THE ORIGIN OF THE LONGITUDINAL DUNE: A REVIEW*

W. ARMSTRONG PRICE

ONE of the most disputed features of dune morphology is the longitudinal dune. New information on its origin and on other eolian phenomena is given in two recent publications, one from North Africa, the other from Australia. In "Le déplacement des sables éoliens et la formation des dunes désertiques, d'après R. A. Bagnold" Robert Capot-Rey, with Françoise Capot-Rey as collaborator, in effect extends his "Dry and Humid Morphology in the Western Erg"¹ in the light of Bagnold's stimulating work on "The Physics of Blown Sand and Desert Dunes"² (of Libya). The other publication is the late C. T. Madigan's report on the sand formations of the Simpson Desert as studied on his expedition of 1939.

Capot-Rey finds Bagnold's work original in method and results and on the whole confirms its application to the French Sahara, where the climate is less arid, the underlying topography more diversified, and a geographical variation in wind pattern rules dune development. Associated with the morphological problem is the problem of terminology. Variations in dune type and the corresponding regional variations in local terminology of native origin have resulted in a complex synonymy. Thus in the French Sahara, *sif* (plural, *sioif*), the Arabic name of the slip face of a barchan dune (Capot-Rey, Pl. 1, Fig. 3), here commonly recurved as a flat S,³ has been extended to the whole dune and has, in fact, come to denote nothing but an active dune (p. 72). Bagnold, however, applied *seif* (*sif*) to the great longitudinal dune chain of Libya as well as to its individual slip faces (Bagnold, Pl. 13, Fig. b); it seems clear from Capot-Rey's paper, although it is not so stated, that *sif* would apply equally well to the slip faces of a transverse dune. In Capot-Rey's region the longitudinal dune is called *draa* (French, *bras*); it differs considerably from the Libyan representative. Where the *draa* is low and simple, it is called *elb* (plural, *aleb*).

Barchans, fairly numerous in scattered areas, but rare considering the great expanses without them, have several names. The detached summit is called *qôrd* and *ghourd* as well as *sif*. The "mastodon" ridged peaks are *ghourd* or *oghroud* (*oghourd* of Gautier). They are shown in the photographs as rising from the longitudinal dune.

From the work of Bagnold, Capot-Rey, and Madigan at least three subtypes of longitudinal dunes may be distinguished, depending on wind regime, sand supply, and invasion by vegetation:

*Robert Capot-Rey and Françoise Capot-Rey: *Le déplacement des sables éoliens et la formation des dunes désertiques, d'après R. A. Bagnold*. Diagr., ill., bibliogr. *Trav. de l'Inst. de Recherches Sahariennes*, Vol. 5, 1948, pp. 47-80.

C. T. Madigan: The Simpson Desert Expedition, 1939—Scientific Reports, No. 6: Geology—The Sand Formations. Diagr., ill., bibliogr. *Trans. Royal Soc. of South Australia*, Vol. 70, 1946, pp. 45-63.

¹ R. Capot-Rey: Dry and Humid Morphology in the Western Erg, *Geogr. Rev.*, Vol. 35, 1945, pp. 391-407.

² London, 1941. (Reviewed by H. T. U. Smith, *Geogr. Rev.*, Vol. 33, 1943, pp. 170-172.)

³ Result of a strong asymmetry of the wings of the barchan.

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1. The "sand ridge"⁴ of the Simpson Desert, Australia. These are ridges which from the air seem rather smoothly rounded (Madigan, Pl. 5, Fig. 2) but are asymmetrical in cross section (Madigan, Fig. 4, on p. 51). On one side slip faces have developed at local summits, convex leeward, sinuous, and lateral to diagonal, in places dying out in the saddles, but nowhere of barchan type. The crest of the ridge is wavy, becoming serrated on the larger ridges. The lower flanks (plinths) have a scattered growth of cane grass or a fairly close covering of grassy vegetation (Madigan, Pls. 5-8). Somewhat more irregularly crested dunes of this type occur in Libya (Bagnold, Fig. 79, on p. 224) but have barchanlike slip faces and lack flank vegetation.

2. The draa of the French Sahara. The broad bare ridges of this type reach greater heights than those of the next type, with two to many lines of slip faces, mostly aligned longitudinally (Lelubre, Pl. 1, Fig. 4). Where the longitudinal dune is wide, a field of transverse dunes formed under flank winds is present, giving the draa an exceedingly rough, ridged, cellular, or alveolar surface. The lower flanks bear a light growth of scattered vegetation (Capot-Rey, Pl. 1, Figs. 1, 2, and Pl. 2, Fig. 2; Lelubre,⁵ Pl. 1, Fig. 4). In the photographs the mountainous oghroud is seen to rise from the draa with radiating ridges of barchan type inclined to peaked summits. Presumably, the *demkha* (Capot-Rey, Pl. 2, Fig. 1) also forms on the draa, though Capot-Rey does not give the range of association of either "mastodon."

3. The Libyan longitudinal dune, Bagnold's "seif chain" or "seif dune." These are bare ridges without vegetation on the plinths. The slip faces are numerous, with the re-entrant, concave barchan type prominent; they cross the ridge transversely and run diagonally down the sides (Bagnold, Pl. 12, Fig. a; Pl. 13, Fig. b).

Capot-Rey adopts Bagnold's analysis of longitudinal-ridge development by the elongation by strong winds of the sand swept laterally by persistent gentle flank winds. He considers that the (supposed) regular spacing of longitudinal dunes requires some special mechanism, which needs further experiment and study. Because of the difficulty of deriving the longitudinal dune from the barchan, he says, an independent origin must be sought. It is evident that the slowness with which scientific articles have been circulating across seas since the beginning of the recent war prevented Capot-Rey from seeing Madigan's paper, as it prevented him as late as 1943 from seeing Bagnold's book when he was writing on the Western Erg.⁶

Capot-Rey discusses the transition from barchan to parabolic dune where vegetation retards only the wings of the barchan. The mountainous oghroud, he suggests, may have been formed by storm winds blowing in opposite directions. He thinks study of the movement of wind and sand over curved surfaces of eolian origin may be important for an understanding of the origin of the great "mastodon" dunes (p. 47). He notes that where a solid obstacle in a sand-bearing wind stream has suitable dimensions and a plane surface

⁴ Only in the works of Madigan and at least some other Australians is the term "sand ridge" fairly definitely used, and then only for the Simpson Desert. Elsewhere the term is variously used.

⁵ Maurice Lelubre: Une reconnaissance aérienne sur l'Edeyen de Mourzouk (Fezzân), *Trav. de l'Inst. de Recherches Sahariennes*, Vol. 5, 1948, pp. 219-221.

⁶ R. Capot-Rey: La morphologie de l'Erg Occidental, *Trav. de l'Inst. de Recherches Sahariennes*, Vol. 2, 1943, pp. 69-104.

which is directly opposed to the wind, sand will accumulate in front of the obstacle, not touching it, as Bagnold seems to say.

Madigan rejects a barchan origin for the longitudinal dune and shows that Bagnold (pp. 176-180) had, but apparently neglected, the experimental evidence for what seemed to Madigan to be the true origin, namely through the transverse instability of wind and sand drift over a uniform plane surface. Bagnold interpreted the parallel strips of sand (Fig. 61, on p. 179) developed in certain of his experiments, notably where there were surface irregularities, such as a layer of pebbles, as due to such instability.

Madigan applies the new theory to the Simpson Desert, where his last expedition threw further light on critical points and revealed important differences from the observations made on his aerial reconnaissance in 1929.⁷ The great longitudinal dune ridges are not uniformly spaced (Madigan, Pl. 5, Fig. 1), even approximately. The smaller ridges, of irregular lineation, are more closely spaced than the larger ones; frequently they join to form a Y. The fact that the stem of the Y invariably points to leeward and the arms to windward is explained as due to the more rapid lateral movement of the lee ends than of the windward ends, because of their smaller bulk. The minor ridges represent sand bodies moving laterally against the major ridges. When the latter reach a certain height, they catch all the sand moving toward them and become permanent dunes, or the "wind obstacles" of Bagnold.

The occurrence of the small interdune longitudinal ridges in all parts of the desert indicates that longitudinal dunes originate in all parts and not only on the windward borders, as some writers have assumed. Terminal migration to leeward is characteristic, the excess sand blown from the end of the dune forming a low fan.

Nowhere in the Simpson Desert did Madigan find barchanlike slip faces or barchan structures associated with the longitudinal dunes or otherwise, though his illustrations show that the convex slip face may trail off with a recurve and there approach the concave form of the barchan sif (Fig. 3), though the slip face is lowest where it should be highest. The true barchan is highest where the concavity of the slip face is greatest.

Madigan shows (p. 63) that longitudinal dunes of the Simpson Desert not only are partly stabilized by grass but are also hemmed in down-wind by a region of less aridity, so that "no material extension of the sandridge area is possible under the present conditions, which appear to have reached a state of balance." Aridity "may have reached its peak." The cover of cane grass is not thought to be a symptom of amelioration of climate but might have developed during aridity; "as it would have taken this flora a long time to originate and colonize the vast areas involved."

Madigan was unable to construct a wind rose for the Simpson Desert. "The strongest side winds blow from between north-west and south-west, with a preponderance of north-west winds in the north and south-west winds in the south. Towards the east, north-easterly winds are more frequent than towards the west, though not often strong. It is impossible at present to be more exact than this" (p. 60). Capot-Rey refers to published wind roses for parts of the Sahara. It is evident that in both places there is a strong longitudinal wind and a fairly

⁷ C. T. Madigan: An Aerial Reconnaissance into the South-eastern Portion of Central Australia, *Proc. Royal Geogr. Soc. of Australasia: South Australian Branch*, Sess. 1928-1929, Vol. 30, 1930, pp. 83-108; *idem*: The Australian Sand-Ridge Deserts, *Geogr. Rev.*, Vol. 26, 1936, pp. 205-227.

wide spread of lateral winds; the wind rose for the Simpson Desert would cover at least 135° to 225° of angular spread.

The chief contribution of Madigan's study of sand dunes is its seemingly satisfactory explanation of the origin and development of the longitudinal dune, based on Bagnold's wind-tunnel experiments and on his own field work and study of the literature.

The distinctive contributions of the Capot-Rey paper are: (1) confirmation for the French Sahara of nearly all Bagnold's applications of his experiments to dune forms and origins; (2) identification and general cataloguing of the dune forms in the region; (3) description of the draa variant of the longitudinal dune; (4) excellently clear illustrations of the oghroud and the demkha and of the occurrence of the former on draa, though without discussion of this association; (5) suggestion of the need for studies of sand flow along curved eolian surfaces; and (6) exposition of the variations in dune terminology where native African terms are used, which reveals (to the reviewer at any rate) that the term *sif*, or *seif*, has many conflicting usages, at least among scientists. The discussion of dune spacing is now outdated by Madigan's paper, and the hypothetical transition of barchan into longitudinal dune seems to be denied as a general or normal mode of origin of the latter.

These two papers again emphasize the dependence of the longitudinal dune on a sandy desert environment and complete aridity of climate. The only case known to the reviewer of longitudinal dunes now growing in a desert margin is that of certain stabilized longitudinal dunes in Arizona which have their windward ends in an arid area or on scarps extending to the edge of an arid valley and on which activity is reported to extend into the adjacent semiarid region.⁸

⁸J. T. Hack: Dunes of the Western Navajo Country, *Geogr. Rev.*, Vol. 31, 1941, pp. 240-263; *idem*. The Changing Physical Environment of the Hopi Indians of Arizona (Awatovi Expedition, Peabody Museum, Harvard University, Rept. No. 1), *Papers Peabody Museum of Amer. Archaeol. and Ethnol.*, Harvard Univ., Vol. 35, No. 1, 1942.

SOME CURRENT PROBLEMS CONCERNING THE UNDERSTANDING OF AFRICAN VEGETATION

H. B. GILLILAND

In the June, 1949, number of the South African Geographical Journal H. B. Gilliland described Gillman's "A Vegetation-Types Map of Tanganyika Territory" as a milestone along the road of advancement in study of African vegetation. He expressed the hope that "in course of time we may achieve as satisfactory a dynamic account of the vegetation of the continent as was so painstakingly worked out for North America by Clements and his co-workers" The editor of the Geographical Review invited Mr. Gilliland to amplify this interesting statement.

THE recent African Regional Scientific Congress held in Johannesburg¹ is symptomatic of a general trend in Africa today to think in Pan-African terms and to relate regional problems to their wider continental setting. This is true in particular in the study of the vegetation: a unifying hypothesis is required before further advance is possible. The success of American plant geographers in producing a dynamic picture of North American vegetation is not unconnected with the necessity for the broad view imposed by the continentality of the United States.

Understanding of African vegetation has grown through two chief lines of research, the systematic and the ecological. The systematic approach has resulted in a plethora of local "floras" and "check lists", and also, it should be noted, in the two classic works of the Kew Herbarium--the "Flora Capensis," dealing with the region from the Cape to the Limpopo, and the "Flora of Tropical Africa," dealing with the rest of Africa south of the Sahara. In the local studies there has been much presumption in geographical differentiation: a species recorded from, say Upper Senegal, would, without sufficient check, be considered different from one recorded from the lower Zambezi Valley. One of the notable contributions made by later "floras" emanating from Kew has been to reduce many names to synonymy and to recognize the wide recurrence of plant forms on the African continent. This recurrence has become forcibly evident with regard to genera; species concepts still remain fluid. It would be a great help to plant geographers if systematic workers when separating species largely on geographical grounds, would draw attention, as a matter of course, to closely related species, such as are referred to as "vicarious species" or "a species pair."² Today the principal difference the investigator notes when contrasting the views of the great botanist and plant geographer Adolf Engler shortly after the turn of the century with those current today is the emergence, ever more clearly, of the Pan-African element in the flora.

With the progress of systematic botany other geographical-systematic elements and their link with geological history have also emerged more clearly. Thus an element common to South Africa, South America, and Australia (for example, the Restionaceae, the Proteaceae) tends to be described as a "South Gondwana" element, and an element common

¹ See Th. Monod: Two African International Scientific Conferences, *Geogr. Rev.*, Vol. 40, 1950, pp. 309-312.

² Ronald Good: *The Geography of the Flowering Plants*, London, New York, and Toronto, 1947, p. 189. (Reviewed in the *Geographical Review*, Vol. 39, 1949, p. 168.)

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to South Africa, East Africa, Madagascar, India, Malaya, and northern Australia (for example, the Flacourtiaceae) tends to be described as a "North Gondwana" element. Both these terms originate from the Wegener hypothesis of continental drift and A. L. du Toit's admirable exposition of it in "Our Wandering Continents" (1937).

One of the most striking features of certain nonpandemic elements is their occurrence by what Weimarck has called "intervals," that is, by discontinuity.³ Thus what might be called a "North Temperate" element (for example, the Ranunculaceae) is at present found in areas with a high rainfall or in riverine sites at high altitudes in the Central African mountains and at low altitudes in the south. Similarly, desert forms are found fringing the true Sahara, on the Red Sea coast, in the Somalilands, in Kenya and Tanganyika, and in the Kalahari and the deserts of southwestern Africa. Strikingly peculiar endemics such as *Welwitschia mirabilis* in the southwest and *Stangeria paradoxa* in the southeast also occur, relics perhaps of a very ancient pre-continental-drift flora (?).

The introduction of an ecological outlook into African field services has been largely a spontaneous development within the systematic framework, though of late a number of government posts for "ecologists" have been created. Unquestionably there is a growing tendency to regard field problems as demanding a synthesis of all relevant information. For instance, the demonstration of climatic fluctuation in Quaternary time is steadily increasing in importance. It has been of inestimable value to the contemporaneous development of archeological research, which in turn has served as a stimulus to further research into climatic variations. Discoveries ranging from the fluctuations of the ice on Mt. Kenya⁴ to changes in river terraces in South Africa,⁵ together with Frederick E. Zeuner's recent monograph on "The Pleistocene Period" (1945), allow one to suggest, very tentatively, that the ice ages of Europe were paralleled in Africa by pluvial and interpluvial climatic periods.

From their geographical position it is reasonable to assume that the Bight of Biafra and the East African mountain backbone stretching from Table Mountain to the Abyssinian highlands would always, in interpluvial periods, serve as refuges for relict vegetation with a high water requirement and, on the return of pluvial conditions, would act as reservoirs for its renewed advance. Thus we may assume that advance and retreat about the East African mountains and the Gulf of Guinea provided the motive force for the changes and impulses of migration. The peculiar distribution of the various African floral elements should then be susceptible of analysis.

These elements are in large measure characteristic of vegetation types—dare one say "pan-climaxes"?—such as tropical rain forest, woodland with tall grass, woodland with short grass, grassland, montane forest, desert scrub, desert succulent vegetation, mangrove, and the host of maritime types. Again very tentatively, it might be suggested that the tropical rain forest and woodland with tall grass represent the endemic African vegetation. The

³ H. Weimarck: Phytogeographical Groups, Centres and Intervals within the Cape Flora, *Lunds Univ. Årsskrift*, N. S. Sect. 2, Vol. 37, No. 5, 1941.

⁴ Erik Nilsson: Quaternary Glaciations and Pluvial Lakes in British East Africa, *Geografiska Annaler*, Vol. 13, 1931, pp. 249-349; reference on pp. 267-271.

⁵ P. G. Söhnge, D. J. L. Visser, and C. van Riet Lowe: The Geology and Archaeology of the Vaal River Basin, *Union of South Africa Geol. Survey Memoir* No. 35, 1937; and H. Breuil, C. van Riet Lowe, and A. L. du Toit: Early Man in The Vaal River Basin, *Memoir* No. 6, Archeological Survey, Pretoria, 1948.

evident Central American affinities must not, of course, be forgotten or the newer "karroid" vegetation of the southwestern Cape be neglected. Woodland with short grass may represent the main vegetation of African/Asian affinity; montane forest the channel of migration of north and south affinities; and the maritime formations the links between the desert types. Wegener's hypothesis would remain the only satisfactory explanation of the Patagonian, Cape, and Australian similarities.

It is clear that advance depends on a positive linkage between a vegetation type with its constituent elements and a Quaternary climatic phase. The North American solution of this problem seems to have rested in the first instance on the demonstration of discords in the present vegetation.⁶ Groups of one affinity were shown to flower in spring; autumnal facies formed a distinct category. Relicts of scrub in a grassland or of tall grass in a short-grass prairie indicate a changing territory of formations with changing climate. Quaternary fossil deposits of general remains, or in Europe more especially of pollens, serve to establish the chronology. Africa has few Quaternary deposits, but pollens are found, and it is here perhaps that we have to look for the important missing facts.

The following may be suggested as a working hypothesis. African vegetation has waxed and waned between evergreen rain forest and desert scrub, montane forest and montane grassland, in concord with Quaternary climatic changes of the order of magnitude of the ice ages of Europe; the present climatic phase is one of increasing desiccation, and we may therefore expect an increase of desert and a decrease of forest vegetation as an inevitable result.

The rate of change can be greatly accelerated by land-use practices that indicate a failure to comprehend this inevitability, a fact that has recently been admirably demonstrated with regard to the Karroo, where "Rooigras veld" has been shown by Tidmarsh⁷ and Acocks⁸ to be replaced by "karroo short desert scrub" over enormous areas.

⁶ F. E. Clements: The Relict Method in Dynamic Ecology, *Journ. of Ecology*, Vol. 22, 1934, pp. 39-68.

⁷ C. E. Tidmarsh: Conservation Problems of the Karoo: Retrogressive Processes and Desert Movements, *Farming in South Africa*, Vol. 23, 1948, pp. 519-530.

⁸ T. P. H. Acocks: Vegetation Map of South Africa. (Unpublished.)

THE AMERICAN GEOGRAPHICAL SOCIETY

Arrival of the Director

On June 1, Dr. George H. T. Kimble, formerly Chairman of the Department of Geography at McGill University in Montreal, began his new duties as Director of the American Geographical Society.

Election of New Councilors

At a meeting of the Council on April 5, Mr. John E. Lockwood, partner in the law firm of Curtis, Mallet-Prevost, Colt and Mosle, and Mr. Carl M. White, director of libraries of Columbia University and dean of the School of Library Service, were elected to the Council of the Society.

Medal Awards

At a meeting of the Council on April 5 award was made of the Society's three gold medals: the Cullum Geographical Medal to Professor Hans W:son Ahlmann of the University of Stockholm; the Charles P. Daly Medal to Professor L. Dudley Stamp of the University of London; and the David Livingstone Centenary Medal to Professor Robert L. Pendleton of The Johns Hopkins University (see p. 349).

The Society's Lectures

Mr. Karl Robinson addressed the Society at its Regular Meeting on March 21, at the Engineering Societies Building, Dr. Robert Cushman Murphy, member of the Council, presiding. Mr. Robinson's talk, entitled "Japan Journey," described "the progress being made toward converting a country from an autocratic, feudal regime into a democratic, industrial economy." It was accompanied by an unusually beautiful color film.

On April 18, at the last Special Meeting of the season, Colonel Niall Rankin spoke on "Wildlife in the Antarctic," Dr. Murphy again in the chair. In the course of a five months' visit to the island of South Georgia, Colonel Rankin had ample opportunity to study and photograph whales, seals, penguins, and other wildlife; thus his lecture and slides were both interesting and informative.

At an informal meeting of the staff on May 4, Mr. Walter A. Wood, director of the New York Office of the Arctic Institute of North America, presented the striking photographic record of the Arctic Institute's operation "Snow Cornice" in the St. Elias Mountains (Alaska-Yukon) in the summers of 1948 and 1949 and described the main features of the field program.

German-English Glossary

The Society is pleased to announce the publication of "A German-English Glossary of Geographical Terms," compiled by Eric Fischer and Francis E. Elliott. This volume, edited by Anastasia Van Burkalow, is Number 5 in the *Library Series*.

GEOGRAPHICAL RECORD

NORTH AMERICA

SAND DUNES OF LAKE MICHIGAN AND DUNE TERMINOLOGY. Sand dunes of Lake Michigan are discussed in two recent papers (doctoral dissertations): "The Post-glacial Geology of the Grand Marais Embayment, Berrien County, Michigan," by Glenn Charles Tague (*Michigan Geol. Survey Publ.* 45 [Geol. Ser. 38], 1947, Part I), and "The Glacial and Post-glacial History of the Platte and Crystal Lake Depressions, Benzie County, Michigan," by James Lewis Calver (*ibid.*, Part II). They are here examined in their bearing on scientific dune terminology—an urgent need in dune studies. Further, the two papers focus attention once again on the chronic problem of the flexibility of this terminology (see the reviewer's article, "Saharan Sand Dunes and the Origin of the Longitudinal Dune: A Review," pp. 462-465 in this number of the *Geographical Review*).

For comparative purposes some interpretation is necessary. The local terminology used in both papers is adequate for description of the dunes and for determining and differentiating the positions of successive shore lines of Lake Michigan.

The *foredune* or *foredune ridge* of Tague and Calver is the well-known coastal eolian structure built on a beach ridge. The term "foredune" seems to be well established in this meaning, though it is not limited to coastal representatives. F. A. Melton (A Tentative Classification of Sand Dunes: Its Application to Dune History in the Southern High Plains, *Journ. of Geol.*, Vol. 48, 1940, pp. 113-173; reference on p. 122) called such a dune a "source-bordering lee dune." Tague calls a foredune that has been made irregular or sinuous by a series of small blowouts a *dune ridge*, a general term without specific connotation. Bow-shaped and U-shaped dunes occur in large numbers in the areas described and are included under the term *parabolic dune*. Some writers are opposed to the use of "parabolic" as a unit or group name. The reviewer is inclined to restrict "parabolic" to an open, bow-shaped structure developed from a spot blowout that has not migrated, and to use "U-dune" for the longer, clearly U-shaped dune developed from a spot blowout that has migrated. "Upsiloidal," suggested by H. T. U. Smith (Sand Dunes, *Trans. New York Acad. of Sci.*, Ser. 2, Vol. 8, 1945-1946, pp. 197-199) for this type of dune, might be used more broadly to include all bow-shaped, U-shaped, and V-shaped dunes, forms associated with spot blowouts and small areal blowouts. The maps and photographs with the two papers under discussion show the U-shaped dune to be abundant here, and the bow-shaped parabolic to be common in some areas, rare or absent in others. Tague distinguishes between a "parabolic" dune that is highest at the point of maximum convexity, which he calls an *apex dune*, and one whose apex has been cut down to form a low ridge "beyond the saddle," which he calls a *saddle dune*, but such modifications of dunes are too numerous to be included in a general classification. Moreover, the description of the saddle dune is not entirely clear. The position of the "saddle" is not described, though the context seems to indicate that it replaces the "apex" after a blowout.

Tague defines a *longitudinal dune* as "a ridge lying parallel to the direction of the prevailing wind." He applies the term to the lateral lag ridges of a traveling blowout that has continued through the apex of the parabolic dune it has formed, dismembering it. The reviewer would prefer to use "U-dune" where the U shape is preserved and a separate term where the lag ridges are widely disconnected. "Isolated lag ridge" is descriptive but long. Melton called

the "elongate-blowout" dune (U-shaped) with a transected apex a "windrift" dune, which is too suggestive of the general, loosely used "wind drift." An eolian drift of sand, snow, or soil, as commonly understood in North America, is a rather formless accumulation in a hollow or is an obstacle dune.

The term "longitudinal dune" is now commonly restricted to the great longitudinal sand dune of the desert, which, C. T. Madigan (The Simpson Desert Expedition, 1939 — Scientific Reports, No. 6: Geology—The Sand Formations, *Trans. Royal Soc. of South Australia*, Vol. 70, 1946, pp. 45–63) has shown, characteristically originates independently as a primary form on a bare, sand-covered desert plain. It seems best to use other terms for the various short dune ridges of longitudinal extension and secondary or dependent origin. The reviewer has used "tail" (used nontechnically by C. A. Cotton: Climatic Accidents in Landscape-Making, Christchurch, Auckland, etc., 1942, p. 102, footnote 5) as a field term for a longitudinal ridge extending down-wind behind an obstacle or from a fixed dune, such as a shrub-coppice dune. "Finger" is convenient for a similar ridge extending down-wind from a gap. R. A. Bagnold (The Physics of Blown Sand and Desert Dunes, London, 1941, pp. 188 ff.) used "sand shadow" and "sand drift" respectively for these two forms.

Tague mentions the occurrence in many places of "waves or transverse ridges" lying within the arms of a U-dune; it was "not uncommon to find as many as three waves in a single dune." He believes that these may be migrating foredune ridges, inasmuch as they branch in places from foredunes. The illustrations, however, especially Plate 2, show plainly that these ridges are true transverse dunes of bare sand which have migrated as a small dune field on an eolian "fan," or surface of bare sand developed between the arms of a U-dune by its migrating spot blowout. This is a common association. One would not expect a transverse dune, a bare sand form, to develop from a foredune, a stabilized, vegetated form, except through an intermediate blowout and fan. An accident, such as abrupt denudation by fire, would leave the sand of a foredune free to migrate. In most cases its material would soon be spread out down-wind, where it might develop one or more transverse dunes. Sudden denudation would permit a foredune to pass directly into a transverse dune only if it lay at right angles to the resultant dune-making wind. Foredunes are oriented along the contact between the sand source area and the vegetative cover or other roughness that stores the wind-blown sand. Hence they trend at angles from 0° to as much as 75° to the dune-making wind.

The transverse dunes of the corridor of an upsilonal dune are typically bare until stabilization begins. In the final stages the swales between the transverse dunes may be blown down in hot months to low positions of the water table and in the cooler and rainier parts of the year become rain-water ponds. From this stage the floor of the U-dune corridor soon passes into a "stripped plain." Continuation of the process may yield a transverse "etched dune-field topographic grain."

Some misconception is involved in Tague's discussion of the group of dunes here described, which he calls *coastal dunes*. He says: "Coastal dunes have several forms which are all so related that the dune mass is a whole, that is, the various forms as a rule do not migrate as independent units. Dunes may be classified as primary and secondary. The sole representative of the primary dune [found here] is the foredune ridge." To be exact, he is dealing largely with nonmigratory dunes formed in the presence of vegetation—the phytogenic dunes. The local sand supply is not large enough to overcome the vegetation of this humid climate to such an extent that fields of migratory dunes may march inland.

The only migratory dune described is the (primary) transverse dune, occurring here only in small fields developed from blowouts and contained within the arms of the upsilonal dunes. These transverse dunes may be considered secondary only because their small fields are limited inland by a vegetative cover too heavy for their small volume of sand to overcome. On other coasts this is not the case, and in places blowouts in foredunes develop extensive fields of migratory dunes, as on the barrier island of southern semiarid Texas, where the resulting eolian plain has reached a width of one to three miles, limited inland only by the coastal lagoon.—W. ARMSTRONG PRICE

SOUTH AMERICA

THE GLACIATION OF THE SOUTHERN PART OF THE CORDILLERA BLANCA, PERU. Under the skilled leadership of Professor Hans Kinzl of Innsbruck, Austria, an excellent map (1 : 100,000) has been made of the southern part of the Cordillera Blanca of Peru (Hans Kinzl: *Die Vergletscherung in der Südhälfte der Cordillera Blanca [Peru]*, *Zeitschr. für Gletscherkunde und Glazialgeol.*, Vol. 1, No. 1, 1949, pp. 1-28, and separate map). It shows for the first time the exact extent of the crevassed glaciers and the elevations of the innumerable razor-sharp peaks and ridges and forms a valuable contribution to the mapping of the Cordillera Blanca, the northern part of which was mapped previously under the direction of Dr. Philipp Borchers. The map was compiled from field surveys of the German Alpine Club's third expedition in the Cordillera Blanca, in 1939. Some 5000 square kilometers were surveyed by ground photogrammetry, and as a result of the method of mapping, the skill of the technical staff, and the precision with which the cartographic work was done, even under the difficult circumstances of the war, the map can be regarded as among the best of its kind and should prove invaluable to geologists, glaciologists, engineers, and alpinists.

Dr. Kinzl's text describes the geology and, at greater length, the glaciation of the region. The rocks are of Cretaceous age or older and include such diversified sedimentary types as limestone, marl, sandstone, slate, and quartzite. These have all been intensely folded, crumpled, and faulted, and intruded by immense granodioritic bodies. The landscape ranges from precipitous escarpments to low-angle karst flanks and towering pinnacles, interrupted by high plateaus where the creeks are deeply intrenched. Many of the rivers occupy ice-molded valleys. The entire region records the effects of structure and lithology on the physiographic evolution of these mountains.

Present glaciation in the Cordillera Blanca is largely confined to the high crests and summits, which generally consist of rocks intermediate between quartz-diorite and granite. The limit of perennial snow is about 5000 meters. In extent and magnitude the glaciers do not equal the existing Alpine valley glaciers; they are usually steeper, thinner, and more crevassed, and as a result their surfaces are often characterized by rock windows. Extensive firn caps are lacking. From the highest peaks, ranged like serrate combs, long glacier tongues radiate down the slopes and into the valleys. No traces of a complete foreland glaciation during the last ice epoch have been found.

The glaciated region is calculated to cover some 1000 square kilometers; thus it is the most extensive area of glaciation in the tropics. The retreat of the Andean glaciers is noteworthy but as a whole can be traced only from about 1850. From this date on the recession,

with a few exceptions, seems considerable. Comparison of photographs taken by G. Steinmann and W. Sievers in 1908 and 1909 respectively with observations made in 1932 by the first expedition of the Alpine Club shows little or no recession, especially in the higher Cordillera; the reason is probably the local and /or general ice advance about 1920. However, the many photographs taken *in situ* from the same points and directions at different times from 1932 to 1940 clearly show a marked and accelerated recession both vertically and laterally, and numerous surveys definitely confirm this. The reduction may not always be as noticeable at the front edge of the glacier as higher up, along the flanks, or about the underlain rock scarps, where the country rock becomes pierced through and the glacier tongue is completely torn off.

A glaciomorphologic feature of vital importance to the inhabitants of the region is the glacial lakes. These water bodies occupy the interior of the large terminal moraines left behind by the receding glacier; and additional water is supplied them by the melting ice front. Most of the lakes are of this origin. Some are now being formed, others are getting larger; still others, where the glacier has withdrawn from the main valley floor, have reached their maximum size. The existence of such lakes is related to the behavior or habitat of the glaciers and the amount of precipitation. It has been noted that all breachings of morainal lake dams take place in the rainy season, and it is believed that they are linked with a sudden increase in the erosive power of the glacier river draining the lake in times of highest water level. Such ruptures can lead to catastrophic floods. One of the worst tragedies of this kind happened in December of 1941 when a *hualco* carrying a load estimated at 8-10 million cubic meters of water, mud, and rocks destroyed part of the town of Huarás and caused a heavy loss of life. Measures have been taken by the government to prevent such floods, the most effective of which is the artificial lowering of the water level of the lakes.

From the data presented it can be safely deduced that the persistent retreat of the Andean glaciers will in time lead to a gradual decrease in the size and number of the glacier lakes. It is evident from the new map that most of the "secrets" of the Cordillera Blanca are *ad oculos omnium*. Continuing geologic and glaciologic work is planned to increase our knowledge and control and thereby to safeguard the inhabitants; in this task the Instituto Geológico del Perú has been foremost.—WERNER RÜEGG

INTRODUCTION TO BIOGEOGRAPHY. In South America biogeography and ecology are only today beginning to occupy their rightful place in botanical, zoological, and geographical studies. Thus the publication of an "introduction to biogeography" by Professor Pierre Dansereau—lectures delivered in Rio de Janeiro in 1946—is an important step forward (*Introdução à biogeografia, Rev. Brasileira de Geogr.*, Vol. II, 1949, pp. 3-92).

Dansereau considers biogeography under eight categories or "levels": paleontological, paleoecological, "areographical," bioclimatological, autoecological, sinecological, sociological, and industrial. Since 1946, however, the study of ecology has progressed in several directions. If Dansereau were to speak today on the parallelism between the influence of latitude and that of altitude, he would certainly stress the differences between the high alpine climate in low latitudes and the tundra climate in polar latitudes. In the former the daily amplitude of temperature is great and the yearly one is small; frost may occur every night. In the high latitudes, on the other hand, there may be continuous, though short, periods without frost and with a very long day. These points have been well brought out recently

by Carl Troll (Studien zur vergleichenden Geographie der Hochgebirge der Erde, *Bericht der 23. Hauptversammlung der Gesellschaft von Freunden und Förderern der Rhein*, Bonn, Nov. 2, 1940, 1941, pp. 49-96).

According to Frederic E. Clements (Nature and Structure of the Climax, *Journ. of Ecology*, Vol. 24, 1936, pp. 252-284), the climax appears as essentially determined by the climate. During recent years, however, an increasing number of scientists have emphasized the importance of soils and geology also. In tropical regions at least, different climaxes seem to persist on different soils (see the discussion in J. S. Beard: The Natural Vegetation of Trinidad, *Oxford Forestry Memoirs No. 20*, 1945, Oxford, 1946, p. 143). Dansereau's elucidative scheme of the distribution of the vegetation types in conformity with temperature and humidity supposes that the distribution of deserts, grasslands, savannas, and forests depends upon the amount and distribution of precipitation. Today it would be important to add that we do not know whether the distribution of savannas, grasslands, or even deserts corresponds to the real ecological conditions. The great importance of human interference has been recently stressed by Carl O. Sauer (A Geographic Sketch of Early Man in America, *Geogr. Rev.*, Vol. 34, 1944, pp. 529-573). J. Lebrun, a connoisseur of the African flora, speaking of the African savannas at the Conférence Africaine des Sols in 1948, declared that in tropical Africa "there is not the slightest inch of ground whereon savannahs are the climactic associations. The actual vegetation is anthropic in character" (*Bull. Agric. du Congo Belge*, Vol. 40, 1949, p. 1976). In a most remarkable book, "Climats, forêts et désertification de l'Afrique tropicale" (Société d'Éditions Géographiques, Maritimes et Coloniales, Paris, 1949), A. Aubréville stresses the same point and doubts whether there is a specific savanna climate in the tropics; and Beard simply denies the existence of a tropical grassland climate (*op. cit.*, p. 144). Thus today there is no certainty at all as to whether there exist ecological conditions of grasslands and savannas in the tropics and, if so, what they are like.

From all this it would seem that human interference is much greater than one would suppose after reading Dansereau's presentation.

There are some noteworthy original contributions to Brazilian ecology; for instance, a scheme of the vegetation of the mountains of Campos do Jordão (between Rio de Janeiro and São Paulo, at 1800 meters above sea level) in its dependence on water and light, and one giving a tentative view of the successions of the shore vegetation near Rio de Janeiro—
F. RAWITSCHER

EUROPE

ACTIVITIES OF THE AMT FÜR LANDESKUNDE. The development of scientific geography in Germany over the last 65 years has been intimately associated with the work of the Zentralkommission für Wissenschaftliche Landeskunde von Deutschland, and this central commission, with F. Metz as its chairman, was largely responsible for the establishment in 1941 of a geographical section, known as the Abteilung für Landeskunde, attached to the Reichsamt für Landesaufnahme. The Abteilung was to serve as an authoritative source for all information on the geography of Germany; it took over in part the business of the Zentralkommission and was under the direction of Dr. Emil Meynen. It was reconstituted by permission of the United States Military Government in 1947 as the Amt für Landeskunde, under the direction of Dr. Meynen, with its offices first at Scheinfeld in Franconia and now in Landshut, Bavaria. This office, with a staff of more than fifty, including nineteen geogra-

phers and eight cartographers, is now the principal authority and clearinghouse on German geography and is responsible for the collection of maps, bibliographies, photographs, and reports on current geographical news in Germany.

The Amt issues its own publications. The *Berichte zur Deutschen Landeskunde*, edited by Dr. Meynen, has been published since 1941. The sixth volume appeared in 1949. This publication contains an exhaustive record of current work in Germany, particularly that which is being undertaken under the auspices of the Amt; it includes biographical notes, a long bibliography of current publications on Germany, and many articles on current research projects. The *Geographisches Taschenbuch*, an invaluable reference for the professional geographer, also appeared in 1949 (see the note in the *Geogr. Rev.*, Vol. 40, 1950, p. 144); a new edition was brought out early in 1950.

Some 14 monographs in the series *Forschungen zur Deutschen Landeskunde* have been published since 1941 in collaboration with the central commission.

In cooperation with the Akademie für Raumforschung und Landesplanung in Hanover the Amt für Landeskunde has also undertaken the preparation of detailed systematic studies of each of the administrative districts or *Kreise* in Western Germany. These will follow a standard pattern and are intended for scientific workers, administrators, and planners; they will be called "Die deutschen Landkreise: Landeskundliche Handbücher für Verwaltung, Wirtschaft und Kultur." A printed bulletin concerning these *Kreisbeschreibungen* lays down the following general chapter arrangement: (1) introductory; (2) the land, including structure and landforms, climate and weather, hydrography, soils, plant and animal geography, the natural unit areas; (3) historical background of settlement, population, territorial organization, economic structure; (4) population distribution, race, folk traits, social structure, and religion; (5) settlement; (6) industry and trade; (7) administrative and cultural activities in their areal distribution and relationships; (8) the cultural complex in its areal structure; and (9) the *Kreis* as a living unit. The Amt has published the study of Kreis Scheinfeld as a model (Verlag Felix Kraus, Scheinfeld, 1950).

Inspired by the initiative of the Amt, several regional agencies have begun to work on similar studies. In Lower Saxony these are elaborated by the Niedersächsisches Amt für Landesplanung und Statistik; the first study was published under the title of "Der Landkreis Hannover" (Walter Dorn Verlag, Bremen-Horn, 1948). In Westphalia the geographical commission of the Provinzialinstitut für Westfälische Landes- und Volkskunde, under the direction of Professor Müller-Wille (Münster), is also preparing *Kreis* studies.

Finally, reference must be made to three detailed map series that are in preparation by the Amt on the scale of 1 : 200,000 for the whole of postwar Germany. These are to show natural units, agricultural units, and sociogeographic units. The concept of the natural unit has been given much attention in recent years in Germany, and important ideas and their application will be found in the publications listed above, especially in the *Berichte*. The idea of the smallest natural unit areas (based upon the assessment of the physical criteria of land, hydrography, soil, and vegetation) and the method of grouping such units into a hierarchy of natural (physical) units, without reference to human occupation, contain much that should be stimulating to geographers. A generalized map of the *naturräumliche Gliederung* of Germany 1 : 500,000, based upon a standardized series on the scale of 1 : 200,000, is being prepared under the direction of Dr. J. Schmithüsen (Karlsruhe), one of the new leaders in this field of study; its publication in 1950 is anticipated. We have heard much in recent years about the theory

of defining and grouping unit areas. Such theories normally start from vaguely defined major units and work downward, becoming more vague as they do so. Clearly, the logical method is to start from the exact definition of the smallest units and work upward, though this demands long, painstaking labor and organization. In this map series and its reduction our German colleagues present us with a *fait accompli*. The second series of maps on the scale of 1:200,000, agricultural unit areas, is to be prepared on the same conceptual basis under the direction of Professor G. Pfeifer (Heidelberg). The third series, sociogeographic units, will determine the smallest areas of human social relationships on which revision of the hierarchy of administrative units might rationally be based. This research is being directed by Dr. W. Christaller, whose work on urban and rural settlements is well known.

Information and articles on these projects, particularly on the work on natural unit areas, will be found in Volumes 5 and 6 of the *Berichte* and in the new periodical *Erdkunde*, edited by Professor Carl Troll (Bonn). The *Berichte*, *Taschenbuch*, and *Forschungen* are available from Dr. Emil Meynen, Amt für Landeskunde, Niedermayrstr. 25, Landshut, Bavaria, American Zone, Germany.—R. E. DICKINSON

AFRICA

TANANARIVE: MOUNTAIN CAPITAL IN A TROPICAL COUNTRY. Perched on its hills, far from sea or river port, Tananarive is a typical example of a political capital that has attracted commercial, industrial, and cultural activities in spite of disadvantages of location and site (Charles Robequain: Une capitale montagnarde en pays tropical: Tananarive, *Rev. de Géogr. Alpine*, Vol. 37, 1949, pp. 273-330).

Before the French occupation of Madagascar, Tananarive was the seat of government of the Merina people and a center of the beef and, in earlier times, the slave trade. The French established their rule here in 1895, with a highly centralized government, and started building all-weather roads that converged on the city and a railroad to the coastal port of Tamatave (finished 16 years later), thus maintaining the political function of the city and providing the initial means for its commercial development. People from the well-populated and well-cultivated plain of Betsimitatatra below the town and from other parts of the island migrated to Tananarive, attracted by the better climate and opportunities for employment and recreation. Population rose from 15,000-18,000 in 1810 to 70,812 in 1925 and now numbers about 163,000. Problems of overcrowding were increased by the ruggedness of the site and inadequate planning. In the maze of ancient stairways, tortuous streets, and jumbled buildings, wider streets and modern buildings have been constructed to facilitate communication by car and truck and to house the larger commercial and industrial firms and wealthier people, but many sections still remain quasi-inaccessible. A dam, 20 kilometers east of the city on the Vaharina River, a tributary of the Ikopa, furnishes electricity, which has now found its way into the smaller streets and native houses. The wide difference in levels within the city made it necessary to bring potable water from Lake Mandrozeza (2 kilometers to the south) up to 1396 meters, and thence to two reservoirs, one at 1360 meters for the lower part of the city, the other at 1454 meters for the upper part; wells are still in use in the outlying districts. In the newer sections garbage disposal by trucks and carts is functioning well, but in the older sections collection is difficult, and the smaller streets and narrow spaces between buildings are often clogged with refuse.

The sewerage system was developed without an overall plan and presents the most complicated problem for the future of the city. Many houses do not face on the street; in places branch pipes would have to be extended as much as 50 meters to reach them. Many streets are too narrow to carry main pipes. Septic tanks number 400 (1932) out of 14,000 houses; open canals, supposedly only for household use and rain water, give off bad odors in the dry season. Sewerage pipes are inadequate to handle the wider distribution of water to a larger population, and after torrential downpours they frequently burst from the excessive pressure down the steep slopes. Unable to find sufficient natural outlets at the foot of the hills, water stagnates in unsanitary pools around the city or inundates the lower sections and brings an invasion of rats. Epidemics of plague were serious until vaccination was started in 1935. Malaria has greatly increased, and a more pernicious form has appeared with increase in communications and in stagnant waters. The natives have been quick to recognize the value of quinine, but unfortunately distribution is insufficient because of the high cost; malaria is believed to have caused 780 out of a total 941 deaths among small children in 1938.

Tananarive and the surrounding uplands contain about one-third of the population of the island—the most gifted, evolved, and active third. This mass of producers and consumers has made the city the commercial capital in spite of the fact that the more lucrative plantation crops, such as coffee, sugar cane, and vanilla, are produced on the lowlands and do not go through Tananarive. It is a large center for cattle, pigs, wood, the produce from market gardens, rice, manioc, and maize, and for overseas importation and distribution of cloth goods, metals, machinery, construction equipment, salt, oils, food and drink, and so on. Industries have followed commerce; and religious and cultural activities have grown apace. It is hoped that better planning in the future will help to solve the housing and sanitary problems of this picturesque and beautiful city and permit it to retain its role of political, commercial, and cultural capital of Madagascar.

PICTURES FROM ETHIOPIA: MARKETS AND CHURCHES. During the years 1942–1945 service with the Anti-Locust Mission took David Buxton into almost all parts of Ethiopia except the extreme west; in the latter part of 1946 he returned to the high plateau for a year in charge of an educational project. An observant eye, a graphic pen, and great photographic skill make truly living pictures of his “Travels in Ethiopia” (Lindsay Drummond, London, 1949): the extraordinary range of scenery, the mixture of peoples, the unique civilization that survived centuries of isolation.

Because information on locusts was profitably obtained where people gathered together, Mr. Buxton frequented the markets. Addis Ababa, a straggling town amid eucalyptus groves—native trees now are scarce on the plateau—has an important Saturday market. It is a good place to observe the motley crowd—predominant Amharas, Gallas, Tigreans from the north, Somalis from the desert, Armenians and Greeks who engage in retail trade, some few Indians and many Arabs, the menial Guraghés from the south. From the new capital the “finest scenic road in Africa” runs northward to Tigré, former center of the Ethiopian kingdom, and its ancient capital Aksum. Eighty miles across the Shoan plateau with its flocks and herds and patches of cultivation brings the traveler to Debra Berhan, where Mr. Buxton spent a year following the rhythm of the seasons and cultivation, the feasts and fasts. Rural life he found pivoted on the churches, the small, round, thatch-roofed churches, “pleasing and appropriate centres for country worship.” Many of them are perched

on the edges of the great gorges that cut into the plateau in the northwest and drain to the Blue Nile. Some of the churches are on shelves in the gorges, for this broken country is comparatively well populated. In past times it served as a refuge for the Amhara population, and soil and shelter are better than on the exposed plateau. Northeast from Debra Berhan the road climbs to 10,000 feet, passes through the "grandiose if unnecessary 'Mussolini tunnel,' " and comes out on the face of the eastern escarpment. In 30 miles there is a drop of more than 5000 feet. Again the road rises, climbing to Dessye, high, bleak, but an important trading town. To the east where the escarpment meets the desert is Bati, a typical border-zone market. Gallas of the plateau meet here in peaceful trade with the fierce, raiding Danakil of the desert at the great Monday market. Farther north, in Tigré, Makallé also has an important Monday market frequented by thousands from the province; it is the center of the salt trade.

At the other end of the country on the shores of Abaya (Margherita), largest of the Rift Valley lakes in Ethiopia, is an interesting market held every four days on the otherwise deserted shore opposite Gidicho Island. Banana root and maize from the highlands are bartered for the islanders' cotton, carried over in boats of the light ambatch branches: the photographs suggest a strong similarity to the balsas of Titicaca. On a ridge overlooking the north end of the lake cylindrical stone monoliths, some still erect, invite the attention of the archeologist. In the north again, the chief interest of Aksum is its pre-Christian antiquities, particularly the famous obelisks: one still standing, elaborately carved from a single block of granite, is 70 feet high. Of interest too are the ancient Greek-inscribed coins washed out of the soil by the rains, a reminder that in those days Ethiopia was a part of the civilized Mediterranean world. In northern Tigré near the Eritrean border is the country's famous and oldest surviving monastery, Debra Damo, which in its inaccessibility is reminiscent of the Greek Athos and Meteora. An appendix to "Travels in Ethiopia," reprinted from *Antiquity* (Vol. 20, 1946), gives an architectural description of the monastery and also of the famous rock-hewn churches of Lalibela in the remote fastnesses of Lasta.

'ASIA

BRITISH DEPENDENCIES IN THE FAR EAST 1945-1949. In the first of a series of annual reports to the British Parliament, the Colonial Secretary, Mr. A. Creech Jones, says: "The Far Eastern dependencies have been chosen as the subject of the first regional report principally because of the complex problems that have had to be faced as a result of the Japanese occupation. The report records notable progress in rehabilitation and reconstruction and also serves to put into perspective the outbreak of Communist banditry in Malaya. It will be seen that the territories are passing from the phase of recovery to that of development, and that action is being taken designed to secure their future prosperity and well-being and to facilitate their constitutional and political advance" (British Dependencies in the Far East 1945-1949, [Command Paper] Cmd. 7709, London, 1949).

The contest in these territories is between the attempts of Communism to bring the 160 million people of Southeast Asia under its control and the intensive efforts of the British to counteract Communist intimidation and blandishments by raising the standard of living, developing democratic institutions, and bringing the peoples as rapidly as possible to the stage at which they can stand by themselves and resist all threats to their independence. Because of the Far Eastern political situation, the British effort is a race against the clock.

The obstacles to its success are most formidable in Malaya. Here (by the census of 1947) the Chinese are now the majority community, numbering 2,615,000; the Malays number 2,234,000, the other Malaysians (i.e. Muslim immigrants from Indonesia) 309,000, and the Indians 600,000. To amalgamate these diverse elements into a nation on the basis of a common citizenship and at the same time to afford the indigenous race reasonable protection against the economic encroachment of the more industrious immigrants from China is obviously a task of the first magnitude, and it has been made more difficult by the Communist insurgence. Taking advantage of the abnormal conditions following the Japanese occupation, a few thousand guerrillas, mostly Chinese, embarked in 1948 on a terrorist campaign. They failed in their attempt to seize power and to sabotage Malayan industry (essential to Britain's recovery program), but their activities have nevertheless created a running sore on the body of Malayan society. To understand the tactical difficulties confronting the British, the geographer has only to be reminded that some four-fifths of the country is still under jungle and swamp.

British Borneo's problems are much more economic than political (the murder of the Governor of Sarawak in December, 1949, is considered to be politically of local significance only). Sarawak is faced by the need to develop a large territory with an inadequate labor force; North Borneo was badly devastated during World War II, and its towns were razed by bombing; but the small protected state of Brunei is rich by reason of its oil deposits.

The position of Hong Kong is unique. Here 1,800,000 people, mostly Chinese, live in comparative peace on the very edge of the Chinese volcano. In the long run Hong Kong's economic welfare depends on stable conditions in South China; its political future depends as much on the wisdom of British statesmanship as it does on Communist ambitions.

All these territories, despite the unfavorable circumstances, have been the subject of a remarkable reconstruction program covering trade and productivity and the health and welfare of the people.

The most numerous people in the dependencies, and the most important politically and economically, are the Chinese. The present writer has spent nearly 30 years in close association with this race both in China and elsewhere. In Malaya, British Borneo, and Hong Kong he has had ample opportunity to observe them at work and at play, on sea and on land, in factories, mines, estates, and remote jungle clearings and fishing settlements, in their homes, in hospitals, and in leper colonies; he has tried their cases as a magistrate, has inspected their schools, supervised their labor and immigration, and, as Protector of Chinese, has enjoyed their domestic confidences. He is convinced that, fairly dealt with, the Chinese of Southeast Asia are in the long run a force, not for sedition or disorder, but for stability and peace.

—VICTOR PURCELL

SELEMIYA, THREE YEARS AFTER. Since the middle of the nineteenth century peasant colonizers have been moving outward along the fringes of the desert in Syria and Transjordan, while at the same time and in the same region nomadic tribesmen have settled down to agriculture. This development is well illustrated in the Selemyia area. In an earlier paper (*Malaria, Irrigation, and Soil Erosion in Central Syria, Geogr. Rev.*, Vol. 39, 1949, pp. 278-290) I gave some details of the achievements of the Ismaili and other colonists here, notably the extension of irrigated land and the replacement of subsistence agriculture by intensive cultivation of irrigated cash crops.

The Second World War brought troops and money into the Middle East. Speculators and contractors became rich, and thousands of poorer men made money as auxiliaries in the Allied armies or in camps and depots as foremen, clerks, mechanics, cooks, and so on. Farmers and sheep raisers sold their products at good prices. In Syria the Allies and the local governments set up, under the aegis of the international Middle East Supply Centre, the Office des Céréales Panifiables, which bought, transported, and sold all grain at controlled and guaranteed prices. The farmers of Selemiya, nearly all of them wheat and barley growers, profited particularly by this, and the standard of living rose perceptibly.

While the war lasted, however, many of its effects remained masked. Money was plentiful, but there was little to buy with it, for imports were controlled and rare. The past three years have been the spending and buying time, as any visitor to Selemiya will quickly discover. Before the war there were in the little town (about 15,000 population) only half a dozen private cars and taxis, no buses, and no trucks; now there are 40 cars, 26 lorries, and 13 buses (estimates by local officials). There is still only one macadamized road, which connects Selemiya with the "civilized west" of Syria, via the city of Hama. But there is a new 15-mile stretch of made-up dirt road connecting an important group of villages with the town, and not only will this—"Allah willing!"—soon be tarred, but Selemiya will also be connected by a metaled road with the city and railroad junction of Homs, 25 miles to the southwest.

The most interesting development in the Selemiya area is the extension of irrigation. Areas that three years ago were given up to the age-old alternate wheat and fallow strip cultivation are now green with vines, vegetables, cotton, and young fruit trees, and in some places the change in the landscape is startling. It is said that almost 12,000 acres of land has been brought under irrigation in the last three years (estimate by local officials). Most of this irrigated land is watered by motor pumps, of which about five hundred have been installed in the vicinity of the town and its 20 satellite villages. American and British pumps, though expensive, are preferred; many of the smaller machines are of cheaper French or Czech construction. The farmers complain that prices are almost doubled by high customs charges, middlemen's profits, and transport costs.

Certain physical conditions, noted in my earlier paper, assure the area a surprisingly abundant supply of subsoil water. The new pumps are installed in wells five to twelve meters deep, which in general tap deeper levels than the old foggaras, the underground galleries that tap the shallower water-bearing strata. As a result, the water table has dropped, and less water lies stagnant on the surface. Not only are more and more wells being put down, but other sources of water are utilized to a greater extent than formerly. Old foggaras are being cleaned out and repaired, surface watercourses canalized, swampy depressions drained and irrigated. Malaria has decreased, and with decrease in malaria have come greater energy and ability and all-round better health. The new developments have also brought an improved diet and readier access to medical services. The wartime antimalaria campaign was rounded off by the Syrian government, which has completed a 15-mile drainage ditch serving the lands of six villages.

The picture is not all bright, however. Will unrestricted installation of pumps continue? At present no one seems perturbed enough about dropping water levels to propose limitation. Many of the foggaras are losing water to the deeper pump wells, and friction between owners seems certain to increase. The water is slightly salty, and although the ground has not yet

become salinized, this may happen. Overgrazing and woodcutting in the Bil'as hills continue, and inevitably soil erosion and floods follow. Old, inefficient farming practices are pursued in the shadow of the new motor pumps, and poverty, ill health, and ignorance are still the lot of the majority. The new agriculture represents the uncoordinated efforts of individuals, when what is really needed is a radical, comprehensive scheme of rehabilitation on a large regional scale, including soil and water conservation and major social changes. Unhappily, such a program is unlikely ever to be realized.

The social changes that have taken place are interesting in their resemblance to developments in other parts of the world and in other periods of economic stimulus. Before 1939 the old landed aristocracy of Selemiya was locally supreme, and the emirs were at the top of the social pyramid. As power has become centralized in the state, government officials rather than hereditary leaders have become increasingly the resort of the ordinary man in need of help. The emirs have lost influence, and the positions they held in local government have been surrendered to professional officials appointed from Damascus. Unending feuds have helped to weaken them, and their social and financial customs have contributed to their troubles. Generosity is a virtue and becomes a fetish; they keep open house, entertain lavishly, live and travel ostentatiously. Now they must have new cars and radios as well as their traditional horses and women. Their servants and the local tradespeople, formerly content with patronage and occasional gifts of wheat, take advantage of the new conditions and demand cash.

A new middle class is evolving, made up of officials, tradespeople, and professional men, and to them the emirs and their like are unwillingly turning for help. Money can be borrowed, at interest rates as high as 50 per cent, but it is safer and more pleasing to lease or sell some of their abundant land. Stories are frequently told of land rented to a newcomer who recoups his rent for several years by the profits on one year's farming. This is economic suicide for the owner, but many of the improvident gentry are driven to it. Others are more successful in adapting themselves to a new life and have become "improving landlords" or have taken to a profession.

Finally, in the eastern part of the area the Bedouins are modifying their mode of life. Sheiks are watching their grazing grounds being transformed by the plow and are finding the change good. The conflict of pastoralist and cultivator has entered a new phase. The sown is being extended at the expense of the desert, which is being made to blossom anew, as in all times of unusual economic activity in Syria.—NORMAN N. LEWIS

THE WATER PROBLEM IN THE MIDDLE EAST. As "water in a thirsty land" is a symbol of well-being in the arid Middle East, so has TVA become a symbol of well-advised development of water resources; hence the title of the article "TVA's in the Middle East" by Feliks Bochenski and William Diamond (*Middle East Journ.*, Vol. 4, 1950, pp. 52-82). The authors describe the outstanding features of some dozen large-scale multipurpose hydro-development projects. Foremost is the scheme for the Nile Basin, a territory of more than a million square miles. As in most of the other Middle East projects, besides the physical problems and the need for resolving conflicting uses of water, there is the international complication: Egypt, the Anglo-Egyptian Sudan, Ethiopia, Kenya, Uganda, and the Belgian Congo are all concerned. The scheme itself is susceptible of regional division—the equatorial projects (Owen Falls and Lake Albert dams, Lake Kioga regulator, the Jonglei Canal diversion scheme in the Sudd region), the Lake Tana storage project, the Main Nile Reservoir. Another

scheme, this entirely Egyptian, is a revival of the old Qattara power plan based on the difference in level between the Mediterranean and the Qattara Depression, midway between the Nile and Cyrenaica (cf. H. Sirry Bey: *The Qattara Power Scheme*, *Geogr. Rev.*, Vol. 19, 1929, pp. 290-292).

In Turkey all water projects except for the Euphrates and the Tigris are contained within the country. The Anatolian plateau is dry and droughty (cf. Sirri Erinc: *Climatic Types and the Variation of Moisture Regions in Turkey*, *Geogr. Rev.*, Vol. 40, 1950, pp. 224-235); cultivated land typically "consists of discontinuous circles whose centers are wells and whose radii are the distance an ox can travel in one working day." On the other hand, streams draining the seaward slopes of the rimming mountains are liable to flooding. The Seyhan Valley, one of Turkey's richest agricultural areas, is annually devastated by the swollen waters. A multipurpose dam above Adana would not only regulate the river but also enable irrigation of almost the entire Adana plain. In the west the Sakarya-Porsuk project aims mainly at furnishing hydroelectric power for an extensive grid. The valley of the Gediz, which enters the Aegean just north of İzmir, is an important grower of commercial crops—cotton, tobacco, fruit, nuts, olive oil. Plans have been drawn up for irrigation, drainage, flood control, and water power, but they have not been coordinated. "In this the Gediz is similar to all other developments in Turkey." However, an American company is now making an overall study of the basin.

In Syria and the Lebanon schemes have been set forth for both the Orontes and the Litani (see below), but in this part of the Middle East primary interest is in the Jordan. Ambitious schemes for its development have been well publicized, but the economic and political questions involved have not been settled. "An investment of this order of magnitude can be undertaken and effectively operated only with the full cooperation of the inhabitants and governments of the entire surrounding area, and perhaps, too, only after at least a measure of economic integration of the region has been achieved."

The problem in Iraq is stated epigrammatically in a newspaper dispatch from Basra: "The great national problem for northern and central Iraq is how to get the water on the land, and the great issue here in the delta of the Tigris-Euphrates valley is how to get the water off the land." At the time of writing (January 23) the highly productive date gardens were being threatened by the rising waters. But Baghdad suffers too from flood when the snows melt in the mountains. As Gertrude Bell puts it in one of her letters describing a "terrific" flood in 1926: "This is a country of extremes. It's either dying of thirst or it's dying of being drowned." Nevertheless, Iraq has perhaps the best agricultural prospects in the Middle East—about 30,000,000 acres potentially cultivable, though at present less than a sixth of this is being cropped. Chief of the construction plans for the Euphrates is the Habbaniyah project to furnish storage and flood control in the depression of that name west of Baghdad. On the Tigris the Kut barrage was completed in 1939, and a control scheme comparable to that of Habbaniyah but on a larger scale is designed for the river north of Baghdad, by means of which surplus waters are to be drawn off into the Wadi Tharthar depression parallel to, and west of, the Tigris. The Tigris and the Euphrates rise in Turkey, and undoubtedly their upper courses have hydroelectric potential, but this has not been studied. In Syria are fertile lands in the Jazira awaiting reclamation. A dam and reservoir on the Euphrates at a locality identified as Yusuf Pasha have been projected, and also a greater utilization of the waters of the Khabur.

In Iran, where physical structure and climate are alike unfavorable, much could yet be done to conserve and increase water supply. It is estimated that three-fourths of the amount now available is lost by surface runoff and evaporation and that only one-tenth of the underground water is recovered by the customary Iranian method of tapping reserves, the *kanat*. The Karun River, which flows into the Shatt al Arab below Basra, offers the largest possibilities both for irrigation and for flood control. Water projects in Iran are part of the overall Seven Year Plan for development of the country. The January, 1950, issue of the *Middle East Journal* includes a sketch of the background and organization of the plan by S. Rezazadeh Shafaq and a summary of problems and proposals by J. D. Lotz of Overseas Consultants, Inc., engaged by the Iranian government to survey the situation and assist in the implementation of the plan.

How feasible are the large-scale projects envisioned for the Middle East? The United Nations Economic Survey Mission for the Middle East, headed by Gordon R. Clapp, chairman of the board of TVA, gives an unequivocal answer in its Final Report (in 2 parts, Lake Success, N. Y., 1949): "At the beginning of its task the Economic Survey Mission cherished a hope—a faint hope to be sure—that several large development projects, devised on the basis of the numerous surveys and reports already made by government missions, private engineers and other experts, could be recommended for immediate exploitation by large capital outlays. The Mission's hope has not been realized. The region is not ready, the projects are not ready, the people and Governments are not ready, for large-scale development of the region's basic river systems or major undeveloped land areas." Turkey and Iran do not come within the scope of the report, and Egypt is referred to only in Appendix IV, which gives an annotated list of projects. The Mission reports on obstacles to development, examines the financial situation (Appendix II) and the research and technical survey requirements (Appendix III), and makes a positive recommendation of pilot demonstration projects. These are four in number: for the Hashemite Kingdom of Jordan, Arab Palestine, the Lebanon, and Syria. Iraq is not included, pending negotiations now in hand for financing the Habbaniyah and Wadi Tharthar projects, nor Israel, because this new force in the Arab world is already well equipped with technical and other resources and aims at a "wholly different economic structure." The Wadi Zerqa project pertains to the largest wadi draining to the Jordan from the east. It embraces road building, construction of a storage dam and check dams and irrigation canals, afforestation, terracing, and creation of a central village; inquiry is to be made into the agricultural system looking to a change from cereal growing to more intensive cultivation of sugar cane, cotton, fruit, and vegetables. A similar experiment is suggested for Wadi Qilt on the right bank of the Jordan. The "investigation" project proposed for the Litani River, "the key to the future of Lebanon," has a prime concern with hydroelectric power, and it is emphasized that the basin must be planned as a whole. Specific mention is made of the need for investigations of geology, hydrology, and meteorology, damsite location, reservoirs, silting, constructional features, cost estimates, power, economics—in short, for the work of a coordinated team of specialists. The Ghab Valley project of the Orontes is another comprehensive scheme that would provide a "veritable small-scale model of the problem of Syria as a whole"; that is, of "problems of drainage, highways, housing, malaria control, public health, village organization, flood control, irrigation, hydro-electric power and agriculture."

It is understood that the U.N. authorized-relief program for Arab refugees—almost

half of those from Israel now are in Arab Palestine and Jordan—will soon be under way and if successful may lead to the execution of the pilot projects for these areas. Appendix IA of the Clapp report deals with the Arab refugee problem, and Section C of Part 2 (Technical Supplement) gives details of relief projects by regions—the Gaza strip, Jordan, Arab Palestine, the Lebanon, and Syria. This problem is also the subject of an excellent concise study made under the auspices of the Royal Institute of International Affairs, "Arab Refugees: A Survey of Resettlement Possibilities," by S. G. Thicknesse (London and New York, 1949).

The findings of the Economic Survey Mission have been discussed in several places, among them the April, 1950, number of the *Middle East Journal*, and they are summarized in "An Approach to Economic Development [in the Middle East]" by Mr. Clapp (*Internatl. Conciliation*, No. 460, April, 1950, pp. 203-217). Our readers will be interested to know that Mr. Clapp will appear on the program of the summer session of the Institute on the Near East at the University of Michigan, Ann Arbor. The geographical work of the session is in charge of Douglas D. Crary.

AUSTRALASIA AND OCEANIA

THE AUSTRALIAN POTATO INDUSTRY. The Commonwealth Bureau of Agricultural Economics, Canberra, is preparing a series of factual surveys of the Australian primary industries. Fifth in the series is a bulletin (1949) dealing with the potato industry. (Preceding bulletins dealt with the citrus, horticulture, fat lamb, and pig industries.)

The principal purposes of the survey on potatoes are to make possible the adjustment of future production to estimated requirements, to consider the possible advantage of a redistribution of the industry, and to discover means of improving production and marketing efficiency. Production and consumption trends, transport and marketing methods and problems, and the possible mechanization of planting and harvesting operations are discussed. Charts and tables present detailed information by states on production, consumption, and trade during the past quarter of a century. Future needs are estimated, on the assumptions that Australian population will increase by 100,000 annually during the next few years and that average weekly consumption will amount to $2\frac{3}{4}$ pounds per capita. Numerous comparisons are made with the potato industry of the United States.

Potatoes are commonly grown in conjunction with dairying, the raising of fat lambs, and cereal or vegetable production. Although potatoes are grown in every state, 65 or 70 per cent of the crop is produced in Victoria and Tasmania. Australian yields average about $3\frac{1}{2}$ tons to an acre, considerably less than in many countries; production in 1947-1948 amounted to half a million tons from 146,000 acres, a large decrease from a production of 881,000 tons from 242,000 acres in 1944-1945, when Australia was supplying food for United States military forces in the Pacific theater. Since the end of the war the wider use of certified seed and fertilizers has helped to increase yields somewhat.

Potatoes are a basic part of the Australian diet, along with bread, beef, and mutton. However, per capita potato consumption decreased from three pounds a week in 1925 to $2\frac{1}{2}$ pounds in 1945-1946 as the use of other vegetables increased. Under normal conditions only small quantities of potatoes are exported, principally to neighboring islands; more than 90 per cent of the crop is consumed at home.

In an attempt to maintain adequate year-round supplies in all markets, as much as 40

per cent of the crop is usually distributed among the states. This large interstate movement is necessary because of the differences in harvest seasons and the concentration of the largest production in the two cool and moist states of the southeast. Tasmania supplies two-thirds of the interstate shipments; red basaltic soils along the north coast of the island are especially suited to potato production. Victoria also sends part of its crop from the moist coastal districts to other states. New South Wales is the principal importer, but both Queensland and South Australia fail to supply local needs. Transport and handling facilities and methods are in need of improvement in order to reduce costs and spoilage.

It is forecast that the Australian potato industry will expand gradually in the established centers of production in proportion to anticipated Commonwealth population growth. By 1955-1956, potatoes are likely to occupy 184,000 acres, with a yield of 650,000 tons. Allowing for continued small exports, shrinkage, and the requisite seed supply for the next year, this will provide 535,000 tons for Commonwealth consumption.—CLIFFORD M. ZIERER

EARLY MAORI GEOGRAPHY. Sir Peter Buck closed his "Vikings of the Sunrise" with the proverb "The old net is laid aside; a new net goes afishing." His recent consummate survey of the Maori people and their culture, "The Coming of the Maori," has been heralded in his native New Zealand as a "towering landmark" and "the best book ever written on the Maori." It would have been appropriate had this culminating product of an outstanding career also carried the proverb on its last page; for it will be many years before we can anticipate, in this field, significant advance on the work of Te Rangi Hiroa. His contribution will long remain the last word on the Fleet Maoris and their culture. But for some time now there has been evidence of a new net going afishing. The old net was concerned primarily with catching and sifting the traditions of the Polynesian folk who reached New Zealand with the great canoe fleet about 1350; the new net is set to catch earlier fish. It is an archeological net cast with the aim of investigating the life and culture of the pre-Fleet inhabitants of New Zealand—the Polynesian Moa-hunters.

Roger Duff's recent reports together constitute a rich haul and give a still richer promise (R. S. Duff: *Moa-hunters of the Wairau, Records Canterbury Museum*, Vol. 5, No. 1, 1942, pp. 1-43; *idem*: *Moas and Man* [Part I], *Antiquity*, Vol. 23, 1949, pp. 172-179; and *idem*: *The Moa-hunter Period of Maori Culture, Canterbury Museum Bull. No. 1* [in press]).

"Moas and Man" is, from the geographer's broader viewpoint, the most valuable. Here Mr. Duff attempts to interpret the accumulating evidence and advances interesting theories about the culture history and historical geography of New Zealand a thousand years and more ago. It seems likely that the Moa-hunters were more numerous than was earlier suspected. They had a material culture sufficiently like eighteenth-century Maori culture for it to be a product of people like the Fleet Maoris, but different enough for it to be regarded as originating in pre-Fleet times. Moa-hunter culture represented a stage in the evolution of recent Maori culture, but it still possessed strong eastern Polynesian affinities.

The Moa-hunters had no cultivated crops and were therefore not dependent on the higher temperatures of the North Island for their principal foodstuffs. It seems likely that the South Island had by far the larger population (compare a map showing the distribution of Maori population in 1780 [unfortunately mistitled "1880"] in K. B. Cumberland: *Aotearoa Maori: New Zealand about 1780, Geogr. Rev.*, Vol. 39, 1949, pp. 401-424, Fig. 4, which reveals a strikingly different pattern). It was the open tussock grasslands and the river mouths,

estuarine flats, and shingle spits of the eastern South Island that provided the principal sites for Moa-hunter settlements. The now extinct moas, crows, swans, eagles, and the fish life of sea, lagoon, and river were the Moa-hunter's major natural resources. He was a fisherman and a fowler, and his economy was simple. His dwelling sites were not fortified, a fact which suggests that the *pa Maori* was a later and essentially North Island feature. Human bones do not occur in Moa-hunter middens, nor were implements fashioned from them. Warfare and cannibalism may thus also have been much later developments. The Moa-hunter used moa bone where the later Maori used greenstone in making personal ornaments, and he depended on a baked argillite where the Maori fashioned his weapons of nephrite.

Mr. Duff's investigations and reports—especially on the Wairau site—are rapidly supplying data of the kind most valuable in the reconstruction of the historical geography of New Zealand soon after the dawn of human settlement.—KENNETH B. CUMBERLAND

SUBAERIAL AND SUBMARINE RELIEF IN THE EAST INDIES. During the past century all phases of the geology of the East Indies have been studied in detail. Since most of the results have been published in Dutch, English-speaking scientists will welcome two recent English summaries that present some of the more important contributions of the past and some of the outstanding problems still to be solved. Much of the material is distinctly geological, but geographers will find many points of interest in the discussions of subaerial and submarine relief.

To geomorphologists thinking in terms of the humid climates of the middle latitudes, "peneplanation" indicates a long stillstand of the land, during which the so-called "normal" processes of erosion slowly reduce the surface to the nearly featureless landscape of old age. In the humid tropics conditions are quite different. Abundant rainfall and high temperatures combine to cause rapid weathering and erosion. So quickly are land surfaces worn down that even in a region of great crustal instability and volcanism, such as Java, peneplanes can be formed. A. J. Pannekoek describes one in northeast Java, still preserved on the summits of the Kendeng Ridge, at elevations ranging from 150 to 250 meters above sea level (*Outline of the Geomorphology of Java, Tijdschr. Kon. Nederl. Aardrijksk. Genootschap*, Vol. 66, 1949, pp. 270-326). It was formed after a middle Pleistocene period of folding and before uplift of the region in the upper Pleistocene. Relatively unresistant sediments contributed to the ease of peneplanation and will in turn contribute to rapid dissection and destruction of the peneplane. It is only because of its very recent formation that remnants of it are still recognizable.

Intensive subaerial erosion is accompanied by rapid deposition. Pannekoek reports that the northeast coast of Java is being prograded at the rate of 50-100 meters a year. Mt. Moeriah, an old volcano on the coast, was an island even in historic time and has been connected with the mainland only within the last few centuries. Similar rapid sedimentation in the Flores Sea is reported by J. H. F. Umbgrove (*Structural History of the East Indies*, At the University Press, Cambridge, 1949). He notes that the investigations of the *Snellius* expedition revealed that the rate of accumulation of terrigenous deposits here is about 7.5 centimeters in a century, or 50 times the average in the tropical Atlantic Ocean. In these sediments there is no distinction, as there is in the Atlantic, between glacial and postglacial material. Either the postglacial deposits are too thick to be penetrated by the 4-meter sampler, or Pleistocene climate in this region was not much different from that of the present.

Another unusual feature of these sediments is that they are unstratified, in spite of the fact that "the alternating rhythm of the monsoons" causes "a marked seasonal variation in the amount of terrigenous material transported to the sea." The lack of stratification is attributed to turbulent mixing during the very slow settling of the fine material. It is reported, for example, "that the ash of the Tambora eruption of the year 1815 has not yet entirely sunk to the bottom."

In the shallow seas of the East Indies the bottom is marked by furrows of two types. Some have been formed by the scouring action of sea currents where they are forced to move through narrow passages. Others are drowned river valleys. The distribution of bottom sediments and the undersea continuation of the alluvial tin ores of Singkep Island furnish further evidence of the submergence of these shallow areas, "either as a result of the post-glacial rise of sea-level or as a consequence of a real downward movement of the bottom, or a combination of both phenomena." There seems to be no doubt that in the deeper basins and troughs submergence is the result of actual subsidence of the bottom, initiated in the not very distant past. Thick sequences of Tertiary nonvolcanic clastic sediments on most of the islands indicate that a land area must have "occupied the site of the present deep sea at the time when the sediments were deposited." Further evidence of subsidence is furnished by atolls and barrier reefs. The steepness of their submarine slopes down to depths of 500 or 600 meters "can only be explained by the up-growth of coral reefs, as neither a talus of loose material nor a submarine volcanic slope ever shows such extreme inclines."

The origin of these basins, their relation to the development of the archipelago as a whole, why the island arc is a double festoon, the relation of volcanism to the structure of the region these are some of the further problems Umbgrove reviews and attempts to solve in his synthesis of the geologic history of the region. With the open mind that should characterize all scientists, he concludes, however, that his synthesis "is only of temporary value, something like a working hypothesis which has to be discarded as soon as new facts are revealed which are incompatible with our present views. Let us not forget that our knowledge of this vast area still leaves much to be desired."

POLAR REGIONS

VITAMIN SOURCES IN ARCTIC REGIONS. Two Norwegian expeditions provided the interesting data reported in the monograph "Vitamin Sources in Arctic Regions" by Kåre Rodahl (*Norsk Polarinstitutt Skrifter No. 91*, Oslo, 1949; Dr. Rodahl has also written a more general account of the data in an article "Arctic Nutrition," *Canadian Geogr. Journ.*, Vol. 40, 1950, pp. 52-60).

In the spring of 1941 a Norwegian sealing vessel, equipped with a laboratory, proceeded to the sealing grounds off Newfoundland for analysis of the vitamin A content of seal liver. From 200 to 1000 seals were killed daily. Results showed conclusively that for the hooded seal the vitamin A content varied with season and breeding ground, and also with sex. The highest content was found in February after the long period of ingestion at the fishing grounds, the lowest content in late spring after the breeding period, during which little is eaten. In general, the male seal had a higher concentration of the vitamin. The Greenland seals exhibited similar tendencies. Various methods of extraction of vitamins and preserva-

tion of the liver were tried, and results indicate that seal livers are a practical and important source of vitamin A. In further tests vitamins B₁ and C were extracted.

The Northeast Greenland expedition of 1939-1940 examined several types of Arctic mammals, birds, and fish for their content, in particular, of vitamin C. Internal organs such as the brain, liver, and kidneys of the musk ox and seal were found to contain much vitamin C. Salmon roe also proved to be rich in ascorbic acid, and birds yielded considerable amounts. The implication resulting from these studies is that "when the natural sources of this vitamin are properly utilised there should be no reason to suffer from scurvy in Arctic regions, even without supplies of fruits or other sources of ascorbic acid from more temperate zones."

In contrast with this, it was found that the European foodstuffs consumed by Norwegian trappers were deficient in vitamin C; even lemon juice, usually considered a good source of the vitamin, lost its value after several months of storage. Tables reveal a heavy fat and protein consumption and a low intake of vitamins A and B₁. Scurvy and beriberi were prevalent among the trappers; the native Eskimo population, on the other hand, did not suffer from vitamin deficiency.

HUMAN GEOGRAPHY

RESEARCH IN URBAN GEOGRAPHY. Geographers interested in research in urban and urban-fringe areas should become acquainted with the provisions of the Housing Act of 1949 (Public Law 171, 81st Congress, Chapter 338, 1st Session, S.1070), which provides financial support on a contractual basis with the Housing and Home Finance Agency for basic research in urban land economics related to housing. Since to the geographer housing concerns residential areas, and since all aspects of urban life relate directly in one or many ways to residential areas, there are virtually no limits to the urban research projects that may be approved under the provisions of this act, except of course appropriations, which are scheduled to total from one-quarter to one-half of a million dollars annually, and the overriding consideration that the research proposed should at least show some fair promise of practical value in throwing light on present or possible future housing problems.

The act provides for the establishment of a Division of Research in the H.H.F.A., under the direction of Richard U. Ratcliff, formerly professor of land economics at the University of Wisconsin. Final approval of research projects rests with the Director of Research and his staff, but a preliminary selection is made by an Advisory Committee for Urban Research, drawing on a diversified group of professional talent, including two geographers. At its first meeting, held in April, 1950, this advisory committee reviewed four projects, dealing with residential mobility, metropolitan decentralization, cost of municipal services for residential areas, and field testing of the design of residential housing.

According to a provision of the act, approval of projects makes possible the utilization of the initial appropriation over a period of four years. This provision removes the principal difficulty, namely that federal funds lapse to the Treasury on June 30 each year, and thus greatly facilitates the basic research often not possible under the limitations of an annual budget. One more provision of the act should be noted: H.H.F.A.'s contractual arrangement must be made with responsible educational, governmental, or other non-profit-making agencies, and projects must be under responsible staff direction. Aside from this understandable limitation, opportunity exists for urban research by graduate students, faculties, or other

competently trained personnel. Research project proposals, to be submitted to the Director of the Division of Research of the Housing and Home Finance Agency, Washington 25, D. C., should be carefully formulated, and their purpose, scope, time schedule, and other significant considerations should be detailed.—MALCOLM J. PROUDFOOT

MECHANICAL METHODS OF FROST PROTECTION. Man's efforts to control the weather have on the whole been ineffective, but in the field of frost protection for orchards he has met with some degree of success. Frost danger arises under two different types of atmospheric conditions: (1) radiation cooling, with development of a marked temperature inversion; and (2) the invasion of a cold air mass, with little or no temperature inversion and a longer duration of low temperatures. It is under the first of these conditions, which includes about 90 per cent of the frost nights in California, that human control of temperature has proved feasible. The most widely used and most satisfactory device has been the oil heater. It warms the air in the shallow layer below the inversion, but it has the disadvantages of high cost and smoke nuisance. Indirectly the smoke makes the cost still greater, because of damage to clothing and house furnishings.

In an effort to eliminate these difficulties investigations have been made recently, in citrus groves of Southern California, on frost protection by mechanical mixing of the air (Robert T. Small: *The Use of Wind Machines and Helicopter Flights for Frost Protection*, *Bull. Amer. Meteorol. Soc.*, Vol. 30, 1949, pp. 79-85). On nights with well-developed temperature inversions the temperature usually increases with elevation up to a level 300 to 800 feet above the ground. If the air can be stirred up, warmer air from the higher levels can be brought down to the surface and prevent frost. The tests demonstrate that a stationary wind machine "is capable of raising or holding the temperature steady over an area of 5 to 10 acres for a period of one to four hours, and one helicopter can accomplish about the same results over an area of 50 to 75 acres of citrus."

These methods are less expensive than oil heaters. It is estimated that the saving per 100 acres would amount to about \$38 an hour for a wind machine (independent of the initial installation cost of \$3200) and \$50 to \$100 an hour for a helicopter. The latter has the additional advantage of flexibility, which permits its protection to be concentrated in the coldest parts of the orchard. In spite of these advantages, however, mechanical protection will not completely displace heaters; for after three or four hours of mixing, the surface temperatures begin to fall because of exhaustion of the supply of warm air. Heaters should therefore be available for use when protection is needed for longer periods or when the mechanical devices break down.

OBITUARIES

ERICH VON DRYGALSKI. On January 10, 1949, Erich von Drygalski, emeritus professor of geography at the University of Munich, died at the age of 84. Polar research was his main field of inquiry, and in the later years of his life political geography and the methodology of regional geography also engaged his attention.

Of major polar expeditions in the "classic" period the leaders of two have been professional geographers—Otto Nordenskjöld and Drygalski. The yield in published scientific results, of both the Swedish and the German Antarctic expeditions, besides including the customary and necessary reports in the various branches of natural science, is characterized by the broad correlations and the syntheses to be expected of the geographer.

At the university of his native Königsberg, Drygalski originally majored in mathematics and physics, but he turned more and more to geography (as Meinardus points out in his memorial in *Petermanns Mitteilungen*, 1949, No. 4) as he came increasingly under the influence of the founder of modern geography in Germany, Von Richthofen, at the Universities of Bonn, Leipzig, and Berlin. Consideration of the problem discussed in his 1887 Berlin doctoral dissertation on the geoidal deformation of the continents during the Ice Age left Drygalski with the desire to study the properties of global ice at first hand. After a preliminary expedition to decide on a suitable locality, he was entrusted by the Berlin Geographical Society with the leadership of its Greenland Expedition of 1891-1893, during which the behavior of the Karayak Glacier as a major outlet of the Greenland icecap was closely studied.

This work and the resulting two-volume account of the expedition (1897) brought Drygalski to the forefront, and he was appointed leader of the German Antarctic Expedition, which was financed and sent out in 1901-1903 by the government of the Reich as part of the international program of renewed and concerted exploration of the Antarctic that had been launched at the time. The expedition's attainment of the continent in the Wilkes sector in about longitude 90° E. and establishment of a station there some 50 miles from the coastal volcano named Gaussberg in an area christened Kaiser Wilhelm II Land are matters of polar history. It was common knowledge in scientific circles in Germany in the first decade of the century that the fact that the expedition had not resulted in far-flung territorial discoveries which would enhance the national prestige had evoked the Imperial displeasure. And yet the 20 large volumes of scientific results (published between 1905 and 1931) better disclose the true measure of the expedition and more truly reflect the national genius.

In the discussion of physical geography in these volumes the treatment of oceanography as well as of meteorology and climate is outstanding. Drygalski himself presents (Vol. 7) a broad picture of the relation of the surrounding oceans to the central continent and demonstrates the existence of colder polar water extending northward to about latitude 50° S., there to sink (along the line or belt later developed mainly by the work of the *Meteor* expedition of 1925-1927 and termed the "Antarctic convergence") under the warmer surface waters as a mighty wedge reaching almost to the equator. The analysis of the wealth of meteorological observations was entrusted to Ludwig Mecking, at that time *privatdozent* in geography at the University of Berlin. The mastery of this material developed the analyst into a polar specialist himself, one evidence of which was his regional geography of the Arctic and Antarctic, a translation of which appeared in 1928 as part of the American Geographical Society's *Special Publication No. 8*. Another evidence of Drygalski's influence on the polar research program of the Society is the Society's advocacy (in "Problems of Polar Research," *ibid.*, No. 7, 1928, p. 281) of the term "shelf ice" instead of "barrier" for the vast amphibious sheets of ice such as that in the Ross Sea, which has found wide acceptance in American polar literature and is increasingly used in Britain. Recognition by the Society of Drygalski's polar achievements was made in 1926 by the award of its David Livingstone Centenary Medal.

The capstone to Drygalski's Antarctic work may be considered three publications of a summarizing and generalizing nature: a regional geography of the Antarctic in Klute's "Handbuch der geographischen Wissenschaft," 1930; a paper on polar nature in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1926, No. 3-4; and a discussion of unsolved problems in *Petermanns Mitteilungen*, 1935, No. 9-10. Joint authorship with Fritz Machatschek

of a handbook on glaciology published in 1942 betokens continuous creative activity in this field over a span of 50 years.

In the fields other than polar research that attracted Drygalski in his later years the methodology of regional geography commanded his attention because of the rather schematic approach that some members of the profession in Germany tended to use. Instead of the systematic discussion in stereotype sequence of the elements that make up the geography of an area, Drygalski, as Creutzburg implies in his appraisal in *Erdkunde* (1949, No. 2-3), advocated emphasis on the characteristic and distinctive traits in the description of a country and stressed the importance of an attractive and clear literary style. Wide-ranging and observant travel in Europe, Asia, and North America had quickened Drygalski's native penetration to essential characteristics. In 1912, as a member of the American Geographical Society's Transcontinental Excursion, he was a close student of the American scene, and he contributed to the Society's Memorial Volume a discussion of marked originality on the Grand Canyon problem. His interest in American geography is carried on, and the catholicity of his teaching is illustrated, by the recent phytogeographic work of his pupil Professor A. W. Küchler of the University of Rochester.

Drygalski's interest in political geography stemmed mainly from the political changes wrought in Germany after the First World War, and particularly in his native East Prussia. An inaugural address in 1921 as rector of the University of Munich on the influence of the character of a country on the development of its people created widespread comment. A paper in 1929 on the geographical bases of the subdivisions of Germany dealt with a related theme, and an essay on space and the state published one year before he died foreshadowed a posthumous book that is awaited with interest.—W. L. G. JOERG

EDWARD LYNAM. On January 31, 1950, the London *Times* reported the death of Dr. Edward William O'Flaherty Lynam, Superintendent of the Map Room of the British Museum for the past eighteen years. Dr. Lynam, although born in England, was an Irishman and was educated in Ireland and in Western Europe. He spent the whole of his working life (aside from service in the First World War) in the famous library of the British Museum, London. Here he had charge of the printed maps and atlases, running into some tens of thousands of items. And more important still, he had the task of assisting all those inquirers and students, both English and foreign, who came to consult the collection. This assistance was generously and ungrudgingly given to all alike; for he regarded himself as a servant of the public and spared no pains to satisfy each visitor. His appointment as a young man rested (as is customary in the Museum) on qualifications in history, languages, and literature, and his earlier researches were in the field of Irish antiquities. Only when, in the ordinary course of promotion, he passed from the great domed Reading Room into the more secluded Map Room did he turn his attention to cartography. As was natural, the ancient maps attracted him most, though less for their geographic content than for their history, engraving, lettering, symbols, and ornament, on which he made himself an authority. His articles and brochures on sixteenth- and seventeenth-century maps are well known and valued by students of historical geography, as well as by connoisseurs and collectors on both sides of the Atlantic. The most recent (1949) was on the "Carta Marina of Olaus Magnus." But perhaps we owe him the greater debt for securing the publication from the Museum of a facsimile in full color of Christopher Saxton's County Atlas of England and Wales (1579), the finest

cartographic achievement of the Elizabethan age, to which he contributed an introduction.

His scholarship was recognized in his native land by the degree of Doctor of Literature, which was conferred on him at Dublin by the National University of Ireland in 1944. His personal qualities as well as his specialized knowledge made him a valued member of many learned societies, and in the Hakluyt Society in particular, which he served as Honorary Secretary and President, he will be greatly missed.

Dr. Lynam's keenest interest was perhaps in very early plans and estate maps and their makers, going back to the days of Henry VIII, and of these he formed his own collection. It was a disappointment to him that he could not persuade the Museum authorities to take the logical step of transferring the manuscript maps from the Manuscript Room, and the maps classed as "prints" from the Print Room (both in remote corners of the vast building), so that all types of maps could be assembled in one place, the Map Room, for comparative study and (although this could not be said) for care and cataloguing by someone who understood them. But ancient British institutions are not logical: the anomaly remains.

Like many other busy people, he promised himself that on his retirement he would settle down to write the books for which he had amassed material, in particular his "History of Cartography." But the long leisure that the task required never came; he died in harness at the age of 64, after exerting himself to the utmost to ensure that his deputy, Mr. R. A. Skelton (who now succeeds him), should be in the position to carry on unbroken the fine traditions of the Map Room. —E. G. R. TAYLOR

GEOGRAPHICAL REVIEWS

MANDATES, DEPENDENCIES AND TRUSTEESHIP. By H. DUNCAN HALL. xvi and 429 pp.; map, bibliogr., index. (Studies in the Administration of International Law and Organization, No. 9.) Carnegie Endowment for International Peace, Washington; Stevens & Sons Limited, London, 1948. \$5.00. 8¾ x 5½ inches.

This book, published after the quiet demise of the League of Nations, is a useful addition to the literature on the mandates system. Mr. Hall has a chronological advantage over his predecessors and can speak with finality from the vantage point of *post factum* perspective; in addition, he has attempted to relate mandates and trusteeship to their "political taproots" and has thus advanced beyond the more sterile legalistic and administrative analyses of the interwar period. The book is thus aimed at a wider audience than, for example, Professor Quincy Wright's monumental "Mandates under the League of Nations," which was the authoritative work on mandates and which in some respects must remain the serious student's most valuable guide to the mandates system because of its more comprehensive and more thorough treatment of the legal and administrative aspects of the system.

Regrettably, Mr. Hall's title is somewhat misleading because, despite its pretensions, the book must be regarded, in justice to the author, as a study of mandates and not of their United Nations successor. Of 291 pages of text, only 15 are devoted to the United Nations trusteeship system; this brief section is designated "epilogue" and does, in truth, seem no more than an afterthought. However, proportionately more of the space reserved for the useful documentary annexes is assigned to trusteeship materials.

In his treatment of the operation of the mandates system, Mr. Hall has had the advantage of access to the notes prepared by Lord Lugard for use in a work he was writing before his death. The analysis is competent and, if not contrasted with Wright's work, comprehensive, though Mr. Hall is no more able than other writers on the subject to reach a definitive conclusion as to the real value of the system to the peoples most directly affected. His general conclusion is that the mandates system did mark an improvement over other forms of administration, but this conclusion is necessarily subject to the qualifications that the statistical data available are not adequate, that noncomparable situations may be involved, and that, in any event, it is difficult to measure the exact impact of the mandates institution as against possible other factors.

In a significant chapter Mr. Hall reassesses the process by which the mandates article (Article 22) was included in the League Covenant. He dismisses the widely held theory that the mandate formula was an "annexationist plot" and presents evidence to indicate that a workable and effective compromise was reached between the legitimate interests of the Pacific Dominions and South Africa on the one hand and the nonannexationist, "sacred trust," principles on the other.

But Mr. Hall's most ambitious contribution, and the one that will be most interesting to readers of the *Geographical Review*, is his attempt to relate the mandates and trusteeship institutions to a geopolitical phenomenon that he calls "the international frontier." In a first chapter under that title, which appeared in modified form as an article in the *American Journal of International Law* (Vol. 42, 1948, pp. 42-65; see also his "Zones of the International Frontier," *Geogr. Rev.*, Vol. 38, 1948, pp. 615-625), Mr. Hall elaborates his theory that the mandates formula and the trusteeship arrangements under the United Nations are the

products of this phenomenon, which he defines as "the zone in which the great powers, expanding along their main lines of communication to the limits of their political and economic influence and defense needs, impinge upon each other in conflict or compromise."

This attractive theory, which meets our modern standards for "realism," unfortunately does not fit the facts. Although Mr. Hall is on firm ground when he speaks of the A mandated territories, i.e. the former Turkish territories in the Middle East, whose status was a bone of contention among the great powers, and perhaps also if the theory should be applied to the former Italian colonies whose status has been a matter of dispute since World War II, the very facts he presents about the origins of the mandates system contradict the theory in its application to the B and C mandated territories, i.e. the backward and underdeveloped areas of tropical Africa and the Pacific. Mr. Hall seems to recognize this when he suggests that the significance of the mandates system lies principally in its applications in the Middle East. He supports the theory also by referring to the system's immediate pre-Versailles origins in Marshal Smuts's "The League of Nations: A Practical Suggestion," which carefully excluded the African and Pacific territories from the scope of the proposed system. But the significant fact is that the system *was* applied to the African and Pacific territories, as a result of the insistence of President Wilson, who represented a power without direct political or territorial interests that would conform to the above-quoted definition of the frontier. Furthermore, a careful examination of the facts would reveal that neither after World War I nor after World War II were the territories that came under the mandates and trusteeship systems respectively any longer on the "frontier." Except for Britain's concession to Belgium by which the latter became mandatory for Ruanda-Urundi and except for several minor border rectifications, the African and Pacific territories taken from Germany were placed under the mandate of the very powers that were already firmly in occupation as a result of military operations. The same powers remained as administering authorities under the trusteeship system, except for the Japanese mandated islands, over which the United States had secured firm control during the war. In both cases then, the mandates and trusteeship principles were applied to territories which were no longer on the "frontier" and which were firmly in the grasp of the occupying powers, as a result not of the operation of political conflicts but because of the force of humanitarian, idealistic, or economic motives. As for the Trust Territory of the Pacific, there is good reason to believe that, to the extent that the territory may have been on a "frontier," the application of trusteeship was hampered rather than facilitated.

Acceptance of the "frontier" theory leaves a somewhat distorted impression of the real significance of mandates and trusteeship. The implication that the trusteeship system is a product of cold war could not be further from the truth. Only in part can it be said that in the United Nations General Assembly "trusteeship became largely a political issue fought out between two blocs." And the further development of the system, although it has become inevitably intertwined with great-power relationships, bears out the conclusion that there are other, and perhaps more important, factors involved. If it is true that mandates and trusteeship are the product of the international "frontier," then the definition of this phenomenon must be extended to include the boundaries between freedom and servitude, between progress and poverty, between ignorance and knowledge.

Despite the shortcomings noted above, Mr. Hall has produced a valuable work. It is certainly provocative.—LAWRENCE S. FINKELSTEIN

TURKEY: AN ECONOMIC APPRAISAL. By MAX WESTON THORNBURG, GRAHAM SPRY, and GEORGE SOULE. xvi and 324 pp.; map, diagrs., ills., index. The Twentieth Century Fund, New York, 1949. \$3.50. 8¾ x 5½ inches.

Recent newspaper dispatches (*New York Times*, April 20 and 21) report progress on a highway connecting Erzurum with the Mediterranean ports of Iskenderon and Mersin and the erection in Erzurum of a small modern slaughterhouse and refrigerating plant for meat processing. These are two examples of the application of E.C.A. funds in a country where the need for development is urgent. Before the formulation of Point Four, Max Thornburg and his associates had already been exploring the possibilities of economic aid to Turkey. This is their pilot study, aimed at producing "the intellectual raw material out of which a more effective U. S. foreign economic policy may be fashioned—not only for the U. S. government but for private business as well."

Besides occupying a position of extraordinary strategic importance, Turkey has a potential importance for its varied agricultural and mineral resources. The question is how to raise to modern Western levels a country so lately a part of the feudal Middle East. It is frankly stated that the purpose of the book is not to praise progress already made by the quarter-century-old republic but to discover weaknesses in the present economic structure. The policy of Etatism, which began coincidentally with the depression and aid from the U.S.S.R., is severely criticized (on Mr. Thornburg's attitude toward private enterprise versus the state see the review by P. G. Franck, *Amer. Econ. Rev.*, March, 1950, pp. 191-194). Thus the basic steel plant at Karabük is described as an "economic monstrosity." The plant is badly sited and has made a heavy drain on the insufficient output of the Zonguldak coal mines and on the inadequate rail transport. In 1946, for instance, demands of the mill caused "thousands of tons of cereals" to be left rotting in the interior plateau. The Karabük plant and other ambitious enterprises bear little relation to the needs of the country, which still is predominantly agricultural and primitively agricultural as well—as practiced "by the Hittites," says Mr. Thornburg. "Between the ox-drawn wooden stick used in tilling the fields for Turkey's food and the foreign-built blooming and plate mill at Karabük, the gap is too great. Unwatered and unfertilized cotton fields, the crops from which must be carried in bullock carts over the nearly roadless stretches of the Cilician plains, are a far cry from the Russian-built spinning and textile mills at Kayseri. Above ground at Zonguldak, the elaborate carpenter shops, garage buildings and recreation parks are in a different world from the wasteful and hazardous operations in the coal mines immediately beneath them."

The establishment of a variety of light industries is advocated—small factories making agricultural implements, processing foods, supplying building materials, consumers' goods, and the like. But the first step, Mr. Thornburg says, is for the state to interest itself in public works; and first among public works is road construction, the improvement that underlies all others. This has indeed been generally recognized. The military aid program of 1947 allotted part of the funds to roads, as necessary for economic as for strategic purposes. The need is illustrated in the comparative figures cited by Robert W. Kerwin in "The Turkish Roads Program" (*Middle East Journ.*, April, 1950, pp. 196-208). By oxcart the cost per ton-mile for labor alone is estimated at one dollar, whereas in the United States truck transport is less than three cents per ton-mile.

"Turkey: An Economic Appraisal" is a lucid and forthright exposition. Its chapters on agriculture, transportation and communication, mining and manufacture, energy resources

and development, and the economy in monetary terms are given an appropriate setting in a brief résumé of the land and the people and their recent history. The summary and critical assessment and the recommendations set out in concise and convenient form points where foreign aid may be desirable. There are many valuable statistical tables.

LES AMÉRIQUES ET L'EMPIRE DES AIRS. By HENRY MOURER. 318 pp.; maps. Les Éditions Internationales, Paris, 1949. 690 fr. 9¼ x 6 inches.

The striking parallel between the emergence of the United States as one of the world's great powers and its rise to world primacy in air transport is the main theme of M. Mourer's volume. Displaying a thorough knowledge of air transportation all over the world, and in the Americas in particular, the author discusses the role of aviation in the concept of "inter-American defense." He emphasizes the necessity of fast and reliable means of communication between North and South America, the lack of adequate connecting roads and railroads, and the consequent importance of air transportation. He describes the development of aviation in Latin America, the international rivalry for predominance, and the final emergence of the United States as the principal carrier. The problems of aviation in Canada and the North American Arctic and of American overseas air lines, and those raised by our participation in World War II, are clearly presented.

It is the author's belief that the airplane has revolutionized the concept of empire. On the one hand the security and defense of nations, on the other free air navigation and free exchange of goods and ideas as manifestations of true international spirit—this is the challenge of aviation to our time.

The airplane has brought the nations closer together, yet because it is a terrifying weapon, it has also kept them apart. Above all, air transportation, by further reducing distances in a world that has been steadily shrinking, should drive home the concept of "one world." In the author's view, the question is: Will air transportation bring about the formation of new empires, or will it become the basis of a new, united world?—GEORGE KISH

THE STORY OF MAPS. By LLOYD A. BROWN. xix and 397 pp.; maps, ills., bibliogr., index. Little, Brown & Co., Boston, 1949. \$7.50. 10¼ x 7¼ inches.

MAPS AND MAP-MAKERS. By R. V. TOOLEY. viii and 128 pp.; maps, ills., bibliogr., index. B. T. Batsford Ltd., London, New York, etc., 1949. 30s. (New York, \$6.75). 10 x 7¼ inches.

In the Introduction to his book Mr. Brown writes: "This is the story of maps: the men who made them and the methods they employed . . . There is no other such chronicle in print." He has made "a survey covering . . . more than five thousand years and involving the personalities and accomplishments of innumerable individuals from every conceivable walk of life." Yet the reader who expects to find here anything resembling a history of cartography will be disappointed. The author, using the word "story" in its correct sense of a personal, independent narrative, has produced a book that will baffle most critics. Although his text runs to nearly 200,000 words, it is divided into only 10 chapters. Each of these introduces such a variety of subjects, handled with so little attention to order or precision, that the real theme can only be conjectured.

Maps are dealt with sporadically in four chapters that are mainly concerned with other

topics. For example, half a dozen prehistoric maps are mentioned in "The Earth Takes Shape" and "The Habitable World"; a few of the medieval *mappaemundi* are briefly discussed in "The Middle Ages"; and charts in general, from the portolans to those of modern hydrographers, are reviewed in "Charts and the Haven-Finding Art." In other, unexpected, places passages occur on such matters as the coloring of maps, engraved cartographical ornament, and attempts in the sixteenth and seventeenth centuries to measure a degree of latitude. Unfortunately, these passages provide the reader with only superficial accounts, and they contain many inaccuracies. Four chapters, however, are devoted primarily to maps. "The World of Claudius Ptolemy" gives a full account of the work of the great Alexandrian in revising the astronomical, mathematical, and geographical knowledge of his predecessors, and of his "Geographia" (ca. A.D. 150), the earliest atlas of the world and still acknowledged to have laid the foundation for all large-scale cartography.

Most of the story of early maps is contained in the chapter "The Map and Chart Trade." It purports to cover the printed atlases and maps from the first edition of Ptolemy's "Geographia" to about 1660; but pages of storybook details are given to a few men such as Ortelius and Blaeu, while the Italian map makers and publishers, Gastaldi, Bertelli, Tramezini, and the rest, who led the world in cartography from 1477 to 1570, are disposed of in a single paragraph, and the period 1650-1700 is dismissed as belonging to "the publishers of commercial maps." These men, often referred to contemptuously but, with the exception of Jodocus Hondius, never named, were guilty, the author says, of issuing maps which had little scientific basis and many mistakes but were tricked out in colors and ornament to attract purchasers. The handing down of the copperplates of obsolete maps from publisher to publisher certainly led to the issue of many unrevised and misleading maps. But in a history of maps one would expect to find a discerning analysis of these very faults—often highly illuminating faults—rather than a wholesale condemnation of them. Indeed, the author constantly shows irritation over, rather than understanding of, the distinctive characteristics of early maps, and this is probably why he fails to be either persuasive or interesting in dealing with them. But he is inconsistent; for most of his favorites and pioneers, Ortelius and Blaeu, the Sansons and the Delisles, were among the keenest commercial publishers. It was to their enterprise and that of scores of others, from Lafreri to Jaillot, from Buache to Arrowsmith, that for nearly four centuries educated people all over the world owed most of their geographical knowledge. Mr. Brown simply ignores the many fine colonial maps, French, English, and Dutch, which were produced between 1650 and 1700 of the American states and the West Indies, writing: "Who had verified distances and directions across the Western Sea? European monarchs had staked out possessions in foreign lands, yet not one of them could locate what he claimed."

The last two chapters, which are concerned with maps constructed by modern scientific methods, show much greater understanding and continuity. The "Survey of a Country" gives a detailed account of the first accurate triangulation of a country, that of France, begun in 1744, of its linking up with the triangulation of England in 1787, of the later English Ordnance Survey, and of the national surveys in European countries and the United States inspired by the example of France. The last chapter, "Survey of a World," continues the story through the nineteenth century, leading up to the international agreement on a uniform style of map embodied in the International Map of the World, 1:1,000,000. Finally the author describes the splendid cooperation of American and English services during the

recent war but points out that immense areas of the world are still only imperfectly surveyed, and that systematic mapping of every country would help to promote international peace.

This book gives a definite impression of having been written entirely from research in books rather than in maps, and of having been completed before the author could utilize his reading with understanding or judgment. Nowhere, certainly, is any map, however important, satisfactorily described or analyzed; and nowhere is there any practical account of the routine work of the early chart or map makers, though that could have been easily introduced in a few brief quotations from such works as William Bourne's "Regiment of the Sea" (1573) or John Norden's "Surveyor's Dialogue" (1607). Much of the book, indeed, is paraphrased from sources mentioned in the text or notes. Thus Strabo's "Geography," on which Mr. Brown has relied far too uncritically, supplies descriptions of ancient Alexandria in her glory and of the prowess of the Phoenicians on many seas; and C. R. Beazley's "Dawn of Modern Geography" furnishes accounts of the early Christian Church, the pilgrimages and the Crusades, Europeans' explorations from the time of Rubruquis to that of Vasco da Gama, and much more. Many of the mistakes, too, can be traced to the author's easy reliance on sources now out of date. Elial Hall has led him to identify the unknown English author of Mercator's map of the British Isles of 1564 as William Camden, who was then only 13 years old; Sir Herbert George Fordham, to postdate the use of the Greenwich meridian on maps by some 50 years; Fischer and Wieser, to make Waldseemüller the author of the first map of Switzerland; and writers before 1885, to commit bad blunders about the "Carta Marina" of Olaus Magnus.

Yet Mr. Brown's general bibliography, though it includes some obsolete works, is full, shows considerable research, and will be useful to experts in the history of cartography. The book is handsomely printed and produced, with many unusual and excellent illustrations, chosen rather for their instructive value than for display. Those depicting the triangulations of various countries and those in the chapters "The Latitude" and "The Longitude," which represent astronomical instruments from the astrolabe to the sextant and different kinds of chronometer down to Harrison's last, are particularly useful.

"Maps and Map-Makers" is a shorter and simpler work. Originally planned as a guide for amateur collectors, it is in fact a carefully arranged catalogue of all the most notable printed atlases, maps, and charts from the first edition of Ptolemy's "Geographia" in 1475 down to 1877. Incomplete and provisional it is bound to be; but this book, packed with titles, dates, and lists and including biographical notes on cartographers and publishers, is remarkably comprehensive. Mr. Tooley, who is a partner in one of the most eminent firms of map sellers in England, possesses, of course, an exceptional knowledge of maps. Indeed, for every one mentioned by Mr. Brown, he probably mentions a hundred. But in carrying out his task he has had to limit his material. National and official maps are excluded, nor do manuscript maps really come into his survey, though he has written very brief accounts of the *mappaemundi* and the portolans. The "map-makers" of his title are sometimes authors but usually publishers. Like Mr. Brown, he omits any account of the different craftsmen whose work gives early maps their human interest and their variety.

The arrangement of the first part of the book is historical. A full chapter is devoted to each of the four great "schools" of map makers and publishers that successively in Italy, the Netherlands, France, and England developed the science and scope of cartography

between 1477 and 1840. Another is given to the sixteenth-century Germans, whose maps, though less well known than those of their contemporaries, were scientifically superior, partly because of the improved surveying instruments devised by such men as Peuerbach, Peter Apian, and Stöffler. Then follow more detailed chapters on the maps and charts of Great Britain and Ireland, in which are included some most useful lists of the marine atlases and charts from 1588 on and of the large-scale county maps that preceded the Ordnance Survey. In the four chapters of the second part the author valiantly essays, not without success, an enumeration of all the important printed maps of America, Africa, Australia, and Asia (including China and Japan). To each chapter is appended a bibliography of works on the maps mentioned. These differ considerably in value: some are incomplete, and others record little-known but useful articles in academic journals. The book is therefore neither a history nor a bibliography of printed maps, but its abundant material renders it a contribution to both. It has one feature in common with "The Story of Maps." Mr. Tooley, perhaps because of his profession, looks at maps from the point of view of a bookman rather than from that of a student of early cartographical methods. He never brings his readers really close to any map, however outstanding, however distinctive in its special characteristics. For him a map tends to be just another item in its appropriate category.

"Maps and Map-Makers" is too ambitious and too crowded for accuracy and scholarship not to suffer. Many important maps are overlooked, and there are egregious errors, as when the author calls Halley "the first to compile mortality tables" and describes Laurence Nowell, an Elizabethan historian and dean of Lichfield, as "a gentleman of Leicester." Several of the lists of maps and publishers are so meager of detail that they fail in their object; there are misunderstandings and confusion in the passages dealing with Halley and with Robert Dudley and his "Arcano del Mare"; and the titles of foreign works are full of misprints. The production, printing, and illustrations are first class and should ensure the book a good sale; but the illustrations, which include more than 60 monochrome plates on art paper, have been selected mainly for decorative effect, so that generally they are less educative than those in Mr. Brown's book. Nevertheless, with all its defects, this is the most comprehensive work on its subject yet published in any language, and one of the most generously illustrated. It is a solid and timely contribution to our general knowledge of a subject that has recently begun to attract a good deal of popular attention and even to find its way into the curriculums of the higher schools. Amateur collectors will find this book most useful; experts, librarians, and booksellers will hardly be able to dispense with it as a reference work.—EDWARD LYNAM †

LA FRANCE. Part 2, France économique et humaine, Vol. 2. By ALBERT DEMANGEON. Pp. 460-899; maps, diagrs., ill., bibliogrs., index. (Géographie Universelle, Vol. 6, Part 2.) Librairie Armand Colin, Paris, 1948. 2200 fr. 11¼ x 7¾ inches.

Demangeon's second volume brings to completion the triad on the geography of France in the *Géographie Universelle*; together the three afford the most comprehensive *tableau* of that country yet available (for reviews of the previous volumes see the *Geogr. Rev.*, Vol. 37, 1947, pp. 340-342 and 682-684). Volume 1 of Part 2 dealt at length with the rural and farming aspects; Volume 2 could almost be called an urban geography of France.

Description and analysis of groups of towns make up most of the book. It is divided into four main parts. The first deals with roads and towns; the second is called "The Sea," but

after two short chapters on fisheries and maritime transportation it also is devoted chiefly to towns—the maritime settlements of the Atlantic and Mediterranean coasts. The third part, “The Industrial Economy,” repeats the pattern; introductory chapters on the history and origin of French industry and on the energy resources are followed by an analysis of industrial regions, which are usually groups of more or less neighboring towns—in fact, in two cases, Lyon and Rouen, the predominant influence and rapid growth of one city created the region. The whole fourth part is devoted to the Paris metropolitan region; these chapters form a monograph in their own right, a revised and enriched version of the little book Demangeon had previously written about the city (“Paris: La ville et sa banlieue,” Paris, 1933). A brief section on France as state and as nation provides the conclusion. The two volumes constitute a standard reference work and a masterpiece of geographical exposition.

Demangeon was the great master of methodology in the French geographical school. His thesis on Picardy set the pattern and became the model for the regional studies that have since been so numerous. The professional geographer may be surprised—and some of the most competent reviewers have commented upon it—to find a sort of hesitation in the general outline of this last book. Certain imperfections can of course be explained by the fact that it is a posthumous work; Demangeon would perhaps have clarified all vagueness with his usual incomparable lucidity of expression had he had the time. The present reviewer, who was close to him in the last years of his life, is inclined to think that this hesitancy reflects, rather, a deep evolution in Demangeon’s thinking. For the main element of surprise is the scattering throughout both volumes of short chapters or paragraphs on traffic and transportation. Several groups of cities are considered along a linking line of transportation, and there is even a most interesting chapter on seasonal towns; i.e. towns whose population and activities vary according to the ebb and flow of seasonal currents within an annual cycle. Traffic and transportation of people and goods, all the network of internal and external relations meant by the French term “circulation,” constitute a potent factor in economic geography, a factor that transcends the field of urban growth and affects all regional life. Two principles of general value may be deduced from the book: the decisive importance of the traffic and transportation factor, and the capital role of cities in the formation of regions, in the partitioning of a territory into economic or cultural units.

The hesitancy of the outline makes one reflect on the artificial and often unreal character of the classic plan for a study in economic geography: production–processing–transportation. Where exactly is the place of transportation and trade in such a “classic” outline remains disputable; Demangeon did not have the time to settle the matter for France, or perhaps he knew his country too well to care about doing so.

This last volume on France concludes the *Géographie Universelle* series. Its 23 volumes, written by well-known geographers and beautifully illustrated, present the most detailed and authoritative description of the world yet produced by modern geographers. It is already a standard and established tool. It possesses the advantage of a remarkable unity and standardization in presentation, achieved at the expense of much endeavor by the publishers. Those who benefit daily by its use may well remember their debt not only to the authors and the man who conceived and planned it, Paul Vidal de la Blache, but also to the technicians responsible for the job, especially M. P. Jolis, director at the Librairie Armand Colin, Made-moiselle N. Seuret, technical editor, and M. Hutin, the eminent cartographer. The series was the work of many people, carrying out the will of an editor who died ten years before the first volume was published.—JEAN GOTTMANN

OUTER MONGOLIA AND ITS INTERNATIONAL POSITION. By GERARD M. FRITERS. Edited by Eleanor Lattimore. xlvii and 358 pp.; maps, bibliogr., index. Issued under the auspices of the International Secretariat, Institute of Pacific Relations. The Johns Hopkins Press, Baltimore, 1949. \$5.00. 9¼ x 6 inches.

CHINESE AGENT IN MONGOLIA. By MA HO-T' IEN. Translated by John De Francis. xvi and 215 pp.; map, diags., index. The Johns Hopkins Press, Baltimore, 1949. \$3.50. 9¼ x 6 inches.

MONGOL'SKAIA NARODNAYA RESPUBLIKA: Fisisco-geograficheskoe opisanie (The Mongolian People's Republic: Physical-Geographical Description). By E. M. MURZAEV. 313 pp.; maps, ill., bibliogr., index. OGIZ, Gos. izd-vo geogr. literatury, Moscow, 1948. (In Russian.)

The publication of several new studies on the land of Genghis Khan comes at a time when Mongolia is again facing a reorientation; the country will perhaps play a vitally important role in shaping the relations between the old Soviet colossus to the north and the new Communist colossus to the south. For the last three decades Soviet Russia's campaign to detach Outer Mongolia from Chinese sovereignty has been based on the implicit promise of gaining for the Mongols real political self-determination and economic equality. Its success was crowned by the 1946 treaty between China and Russia in which China recognized "independent" Mongolia. With the coming into power of a Communist regime in China, there presumably no longer exists an imperialistic government on Mongolia's south border, but instead a regime that is eager to concede equality and self-determination economically and politically to the Mongols. The Russian government, then, can no longer utilize hatred and fear of the Chinese regime as a drawing card for monopolizing Mongolia's trade. Competition between Russia and China for Mongolia's products is therefore on a more nearly equal footing and may well give rise to a point of conflict.

The three works listed here are about as different as they could be. Ma Ho-t'ien's book is a travelogue, sometimes chatty, sometimes reading like the diary notes from which it was derived, at times keenly analytical and descriptive. The author was an early educational commissioner of Kansu (his journey was taken in 1926-1927), and he brings to bear the insight of a social scientist on the conditions he observed. The other two books are systematic studies; Friters deals primarily with political history, Murzaev with physical geography. Together the three books offer a fairly comprehensive picture of Outer Mongolia today.

Murzaev's book is divided into two sections. In the first, general geographical characteristics of Mongolia are described under such subheadings as the geographical situation, the system of Mongolian place names, the state organization, population and economy, historical geography, the fundamental structure of the surface features, the formative stage of the landscape, and the climates. The second section describes the five regions into which the author divides the country geographically. Four double-page maps and several page-size ones show the distribution of such factors as soils, vegetation, zoogeographical regions, and precipitation. Of special interest is a sketch map of what Cressey has called the Valley of the Lakes, showing stages of shrinkage; the vast area once covered compared with the present small areas seems to point toward a desiccation of the water resources and a possible climatic change. The numerous photographs would be of great interest if they were not badly reproduced on poor-grade paper. A large bibliography is included, and an index of terms. Copies of the book seem to be available in several American university libraries and at the Library of

Congress; it is unfortunate, however, that a companion volume on the economy and human geography of Outer Mongolia by the same author published in Leningrad in 1947 apparently is not available in this country.

The introductions to the Friters and Ma books are written by Owen Lattimore. That to Friters on "Mongolia's place in the world" is an important 36-page analysis. In a sense it is a summation from Lattimore's point of view of the developments covered by both Ma's accounts and Friters' more systematic discussion. He looks upon Russia's action in Mongolia as due to a policy intended neither to annex nor to absorb Mongolia, but rather to a desire for a buffer to keep out foreign aggression against Russia. Apparently, he takes no stock in the idea that Russia might be finding control of such adjacent areas as Mongolia a necessary part of a program of outward expansion.

Friters sets forth the historical evolution of Mongolia's relations with other countries under a topical rather than a chronological arrangement. Correlating this compartmenting of events involves a certain amount of repetition, but geographers will be grateful that in a book of a primarily political nature the author presents the geographical background in a single chapter rather than as scattered facts interspersed here and there. Only a brief sketch, however, is devoted to the physical geography, and the reader is referred to the dubious pleasure of Murzaev's book for additional details. A considerably more informative analysis (some 30 pages) is given on the cultural aspects of geography in recent decades. The author is not sufficiently critical of some of the figures for livestock gains, particularly as regards the feasibility of the goals set. He appears to be of the opinion that the target of 200,000,000 livestock "would be feasible in the long run if military priorities are reduced and if the veterinary and technical organization keeps in step." It is easy to demonstrate that such a goal is absurd in view of grassland grazing capacity in Mongolia. The chapter following the discussion on the geography takes up relations with Soviet Russia—a reflection of current interest rather than of the weight of historical material. The 1924–1930 period is described as a prolonged attempt on the part of Soviet Russia to diminish China's trade with Outer Mongolia, an effort so effective that by 1934 more than 91 per cent of Mongolia's trade was in Russian hands. Russian troops brought into Mongolia in 1939 to implement the 1936 protocol of mutual assistance eventually defeated an attempt by Japan to annex part of eastern Mongolia. They were still there when even the Soviet troops in northern Korea had been withdrawn. Friters concludes that "politically, the withdrawal of Soviet troops would make it more difficult for Russia to exercise her restraining influence on 'Pan-Mongolian' ambitions," which presumably would have implications among the Buriat Mongols in Soviet Siberia as well as in Chinese Inner Mongolia, Manchuria, and Jungaria. In this connection, the creation last year under the Chinese Communist regime of the new Inner Mongolian federation might either foster Pan-Mongolian ambitions or, on the other hand, create a rival Chinese-Mongol "autonomous republic."

In the plebiscite by which the people of Outer Mongolia confirmed their desire for independence "no single vote was entered in the column 'against.'" The author comments that, since 60 per cent of the population are illiterate and 98.4 per cent of all citizens entitled to take part are supposed to have voted, the number of voters whose thumb was guided to the right column by some pro-Soviet official's hand must have been considerable.

In describing Japan's relations with Outer Mongolia, the author states that Japan's attitude toward Mongolia in the days of Czarist Russia was based on treaties which gave Outer Mongolia to Russia as a sphere of influence. Friters concludes that in the confused

history of Japanese influence in Mongolia there is a consistency in the method with which Japanese interests were pursued, in that Japanese officers still actively intervened, though the Japanese government never endorsed such intervention and publicly and categorically denied any support. The dispute about the frontier between Manchuria and Outer Mongolia that led to large-scale battles at Nomonhan in 1939 was not so much concerned with the delimitation of boundaries as with the demands of Manchuria to have a formally accredited agent with virtually diplomatic status located in Ulan Bator (Urga) and five other localities with a view to assuring the development of Japanese interests. The result of the setbacks suffered by Japanese forces brought about the ratification of the final border demarcation in May, 1942, six months after Pearl Harbor.

In the concluding chapter, on the present position of Outer Mongolia, Friters describes the unsuccessful application of Outer Mongolia for membership in the United Nations and its unsuccessful attempt to gain a seat on the Far Eastern Commission and gives a brief summary of its recent political and economic position. Appendixes comprise an extensive and valuable bibliography, a glossary of Mongol terms, the text of the Constitution of the Mongolian People's Republic, thumbnail sketches of some Mongol personalities, and a chronology of events from 1688 on. Maps of political divisions, vegetation types, and roads and railroads are included. The last does not show the now completed railroad from Kyakhta on the Soviet border to Ulan Bator, the capital of Outer Mongolia.

Ma's account is divided into six parts by journey stages. The journey starts at Lanchow in Kansu Province of China, goes northwestward through Kanchow, and thence northeastward to Basingto in the Etsin Gol area. From here the author traveled almost due north to Sain-Noin Khan, which is about halfway between Ulan Bator and Uliassutai, and thereafter followed the route eastward to Ulan Bator. The round trip from Ulan Bator to Ulan Ude (Verkhne Udinsk) and back was covered during the author's trip to and from Moscow. Subsequently Ma returned to Lanchow via Basingto and southeastward through Ningsia city. A full translation is given of Parts 2, 4, and 5 only, and of these, Part 4, entitled "At Urga," is the longest and most interesting. The whole account presents an interesting picture of the Mongolian People's Republic during its formative period.

Ma was early impressed by the rigorous political climate in Outer Mongolia. When he first entered its territory, officials of the central government raced "night and day to a banner two thousand li away to investigate us." To him this revealed both the conscientiousness of Mongol officials and their deep suspicions. He later points to the growing political awareness among the Mongols and their participation in political affairs to a greater extent than the average Chinese of the period. His observations confirm the suspicion that Russian control in Outer Mongolian affairs was a very real thing.

In speaking of the social aspects of Mongolian life, Ma writes that the freedom of Mongol girls and women "scandalized" his Chinese servants, and the competence and indefatigability of the women were a marvel to all of them. Like numerous other travelers in Mongolia, he is enthusiastic over the unexploited resources of the country. This very enthusiasm, however, leads one to question his judgment. Coming himself from a farming heritage, he considers that some of the chief obstacles to agricultural development are attributable not only to the undeveloped "water-conservancy" but also to the pastoral heritage of the Mongol. When he gazed on the great stretches of grasslands, he must have sighed regretfully that there were at least one million square li which could be farmed.

Ma gives information gathered concerning the military organization, size, and equip-

ment of the army in 1926 in the detail of an intelligence report. An important aspect of the military situation, aside from the Russian direction and training of the Mongol Army, is the provision of six months of compulsory training for all males over 18 years of age, a rotational system that makes available large reserves to supplement a standing army of fewer than 20,000 men.

As a Kuomintang revolutionary of the early period, Ma was interested in the educational facilities, and he describes the conditions, equipment, and availability of schools, the curricula of the different levels of schooling, and the books used. An ingenious method for the indirect extinction of Lamaism was the provision that no youth under fourteen or not graduated from a grammar school was permitted to become a lama. Those who have graduated from such schools have usually been thoroughly indoctrinated against lama life. The author points out that what is called the Ulan Bator People's University had in reality no qualifications for a university. In 1926 its students had not even graduated from a middle school. It is interesting to note that physical geography was on the general curriculum of both the normal school and the school of politics and law. However, the catechetical method of instruction in geography indicates that the level of teaching at best was on a par with what might be taught in high schools in this country. Nevertheless, there seems to be a great emphasis on the acquisition of practical geographical knowledge about the country. The Scientific Committee of Outer Mongolia had a cartographical bureau. Ma writes that in three rooms of the bureau several people were engaged solely in drawing geographical and scientific maps. He was informed that 15 men had been sent out the year before with more than 30 camels to survey the Outer Mongolian frontiers and investigate mineral resources. This party was away for a year before returning to Ulan Bator.

A perusal of any of these three books on Outer Mongolia will be rewarding to those interested in the strategic and political reorientations going on in the eastern half of Asia today. A reading of all three would qualify one to conclude with Ma Ho-t'ien at the end of his travels: "My ears, my eyes, and my mind were filled with the new and old realities of Inner and Outer Mongolia."—HEROLD J. WIENS

MAJURO: A Village in the Marshall Islands. By ALEXANDER SPOEHR. 266 pp.; maps, diagrs., ill., bibliogr., index. *Fieldiana: Anthropology*, Vol. 39. Chicago Natural History Museum, Chicago, 1949. 9¼ x 6¼ inches.

The native atoll village of Majuro in the Marshall Islands, like various others in eastern Micronesia, has been subject to domination by a succession of outside groups: the traders, the missionaries, the Germans, the Japanese, and now the Americans. But instead of being completely demoralized and disorganized as a result of this series of impacts, the Marshallese of Majuro have ridden out the storms, accepting and adapting what pleased them, rejecting what did not, until today they have an integrated, fairly stable culture.

Dr. Spoehr's monograph is a product of one of the CIMA projects in American Micronesia carried on in 1947. It is a particularly interesting account of the "formal social organization" of the village. The picture he presents, although it has some distinctive aspects, is fairly representative of many other atolls of the Trust Territory. The primary foods, for example—taro (probably chiefly *Cyrtosperma* rather than true taro), breadfruit, coconuts, *jekaro* (coconut-palm sap), and fish, supplemented by pandanus, arrowroot, and a few minor crops—differ only slightly from those of numerous other atoll villages. Handicraft products

(made from pandanus and coconut leaves) outranked copra as a source of income in 1947, probably because the copra industry had not yet recovered from the depressing influence of the war.

The economic aspects take up only a small part of the monograph, however; the main emphasis is on such anthropological matters as class structure, the household, lineage and clan, and the kinship system. Land tenure is discussed in connection with lineage, since "the lineage is first and foremost a land-holding group." This relationship is one reason why the Pacific islands have presented such excellent opportunities for the practical application of anthropology.

One respect in which Majuro is unusual among Marshallese villages is the dichotomy of its native hierarchy. There are two paramount chiefs, each with his own followers. The two groups are rivals in a number of ways, yet they are able to live together amicably. This dichotomy may well die out in time, just as the whole class structure is tending to disappear and be replaced by one in which special ability rather than birth is the basis for prestige.

In addition to being well written, the book is amply illustrated with sketches, charts, maps (constructed by the author with plane table and alidade), and photographs. It is unlikely that the CIMA investigations will give rise to a more charming product.—

RAYMOND E. MURPHY

SEVEN ACROSS THE SAHARA: From Ash to Accra. By HAROLD INGRAMS. xii and 228 pp.; map, ill., index. John Murray, London, 1949. 18s. $8\frac{3}{4} \times 5\frac{1}{2}$ inches.

THE SANUSI OF CYRENAICA. By E. E. EVANS-PRITCHARD. viii and 240 pp.; maps, ill., bibliogr., index. At the Clarendon Press, Oxford, 1949. 25s. $9 \times 5\frac{1}{2}$ inches.

THE KINGDOM OF MELCHIOR: Adventure in South West Arabia. By THE MASTER OF BELHAVEN (A. HAMILTON) x and 212 pp.; maps, ill., index. John Murray, London, 1949. 16s. $9 \times 5\frac{3}{4}$ inches.

EGYPTIAN SERVICE, 1902-1946. By SIR THOMAS RUSSELL PASHA. x and 294 pp. maps, ill., index. John Murray, London, 1949. 18s. $8\frac{3}{4} \times 5\frac{1}{2}$ inches.

These books have in common a concern with the Arab world, and they illuminate various aspects of the mode of life and thought which make that world a reality.

Mr. Ingrams, after many years of service in the Arab world and a brief interlude with the Allied Control Commission in Berlin, was on his way to the Gold Coast, where he had been appointed Chief Commissioner of the Northern Territories. His narrative deals with "brown" Saharan Africa and its "black" Sudanese fringe. Admittedly he took this "back door" approach to be once again in a land of Arab speech. With his wife, who had shared the 10 years in the Hadhramaut that made their name known throughout the Arab world, and their ménage he traveled the Hoggar route by Ford V-8. Starting from Algiers, the route took him south through the M'Zab oases, El Golea, In Salah, Tamanrasset, Agades, and Zinder, then west to the Niger. As one who came from the "Arab Island," Mr. Ingrams was welcome everywhere, even in the M'Zab, for instance, where the people are by faith Ibadhis, followers of Abdullah bin Ibadh, whose principal stronghold was in Oman. All but a fraction of the journey of nearly 3000 miles from Algiers to Tamale was in French territory, and Mr. Ingrams took full advantage of the opportunity to confer with French administrators. He found that, however far apart French and British theories of colonialism

may be, in practice they are in considerable agreement. He emphasizes the need for West African officials to get together: "If we studied common problems together on the spot, the men in the field, common results might more hopefully be expected at the top on the London-Paris level." It is a plea that has frequently been made by scientists (see, for example, E. F. Gautier in his review of Francis Rennell Rodd's "People of the Veil," *Geogr. Rev.*, Vol. 18, 1928, p. 484), and on the scientific level a most hopeful sign for Africa is the First African Regional Scientific Conference held in Johannesburg last October (*Geogr. Rev.*, Vol. 40, 1950, pp. 309-311). One point worth mention is the use French officials made of Lawrence's "Seven Pillars of Wisdom": the Chef de Poste at In Salah found in it "the answer to every question of how to treat with Arabs."

Crossing the Sahara by car is still "something of an adventure," more so now, indeed, because of the deterioration of prewar facilities and the concentration on air travel. On the Hoggar route is one stretch of 378 miles with only a single well, at In Gezzam, with its lovely shade-giving casuarinas. Mr. Ingrams' narrative enables even those who "don't know deserts" to appreciate "the feeling of travellers who arrive in sight of an oasis." Among travelers met on the way were parties of English trekkers en route to South Africa. Exact figures on the new migration do not seem to be available; French authorities' estimates range from 3000 to 10,000. El Golea reported 30 lorries a month passing through. Many of the trekkers were ill-equipped and ill-advised; it would be interesting to have their stories and know how many of them reached their goal.

The conclusion of the journey found Mr. Ingrams deeply convinced of the pressing nature of the problems of the dependent territories. The economic need is foremost, but social and political progress must keep pace: there is no time for the slow building up of native institutions that is the essence of indirect rule. "Seven Across the Sahara" is not concerned with the subsequent experiences in the Gold Coast, but Mr. Ingrams discusses one aspect of the general problem in an article "Communism and the African" in *Corona* ([the journal of His Majesty's Colonial Service], Vol. 1, No. 6, 1949, pp. 3-6, and No. 7, pp. 11-13).

"The character of the Arabs and of Islam," says Mr. Ingrams, "are both due to the desert, but whereas the latter arises from the solitude and the simplicity, the former comes from the separation of man from man and the struggle for existence." An admirable illustration is afforded by "The Sanusi of Cyrenaica." Professor Evans-Pritchard, a social anthropologist, spent two years in Cyrenaica, mostly among the Bedouin, with the British Military Administration. His book is a sober history condensed from a mass of detailed data (see, for example, his analysis of "Topographical Terms in Common Use among the Bedouin of Cyrenaica," *Journ. Royal Anthropol. Inst.*, Vol. 66, 1946, pp. 177-188). But his liking for, and sympathy with, its subjects are patent. Few countries are more isolated—Despois said that the Greater Syrtis between Cyrenaica and Tripolitania is without dispute one of the most decided frontiers, natural and human, to be found anywhere—or lend themselves better to a segmented tribal system. Three-quarters of the population are Bedouin. Here the Senussi fraternity established itself a century ago under the Grand Senussi, one of Islam's great itinerant teachers. After wandering from Morocco to the Yemen, he settled on the Cyrenaican plateau; in 1856 the mother lodge (*zawiya*) was moved to Jaghbub oasis, and in 1895 into the heart of the desert at Kufra, which became the center of a vast theocratic empire (see map of the distribution of Senussi lodges, p. 24). The Order constituted an

authority binding together the segmented tribes. Under external pressure its sacred head became a secular leader, and the religious organization a government for the loose tribal federation. Senussism was a force to be reckoned with, as the Italians discovered when they took over Cyrenaica from the Turks, and still more so after the rise of Fascism and a tougher colonial policy. It was clear that the power of the Senussi, and with it the tribal institutions, would have to be broken. The Bedouin population was greatly reduced by death and migration to Egypt, where the head of the Order retreated in 1922, not to return to Cyrenaica until 1943. Professor Evans-Pritchard's history ends here; but under the U.N. disposition the Senussi problem is not ended. Can Cyrenaica, Tripolitania, and the Fezzan merge their differences in an independent united Libya? The U.N. commissioner will need the wisdom of Solomon.

In contrast with the warm friendliness of "Seven across the Sahara," "The Kingdom of Melchior" has a bitter myrrh quality implicit in its title. Its author was seconded to the Aden Protectorate Levies in 1931 and later served as Political Officer in the Western Aden Protectorate. His narrative tells mainly of punitive expeditions against feuding tribesmen. In this region the "dark oppression of the feud" is endemic. "The desire was not for seed for the sowing, nor for the help in medicines and learning. The desire of the heart in all this land was for accurate rifles, for the most modern European cartridges." "In a country dominated by blood feuds, new and age-old, no situation, no journey, no camp is a simple affair; . . . there is the seed of envy and malice in every friendship, in every gift." Besides internal troubles, the Protectorate was not immune from trouble with the Yemen, even after the signing of the Anglo-Yemen treaty in 1934. In 1938 an expedition was undertaken to the legendary Shabwa, the Hidden City, to anticipate occupation by the Iman's forces. There was an opportunity for some investigation, and the conclusion is offered that the city is older than had been believed, a holy place, a city of tombs.

The Master of Belhaven compares conditions in the Western and Eastern divisions of the Protectorate. The success of "Ingrams' Peace" in the latter he attributes to system, speedy movement against the arms merchants, and to the way in which Ingrams and his wife, "two great people," lived in their work, firing and directing the ready energies of the tribesmen. Postwar problems in the Western Aden Protectorate show little change. "During 1947 the Western Aden Protectorate continued to suffer from a shortage of experienced Political Officers. This position was aggravated by the murder in April of Mr. P. C. Davey, an officer of exceptional ability and experience" (Colonial Office Annual Report on Aden for the Year 1947, *Colonial Ann. Repts.*, London, 1949, p. 60).

Mr. Ingrams has much to say on the spell of the desert, though, like other devotees, he can find no adequate explanation for it. The Master of Belhaven calls it "a sickness of the imagination," but he admits that this "country of south-west Arabia had magic in it. . . . Not a day will pass in all your life but you will remember some facet of that opal-land."

"Russell Pasha's" earlier years in service with the Egyptian government were spent as subinspector and inspector in the provinces, during which time he traveled in all parts of the country and became acquainted with both fellahin and Bedouin. He tells of the individualism of the fellah; his low and in some respects deteriorating standard of health—for instance, the spread of that debilitating disease bilharziasis with the expansion of perennial irrigation—the high incidence of murder, mainly due to the blood feud; the ambition of the young men of the villages to possess modern rifles. Bedouin justice he found good, though there were likely

to be difficulties on the desert's edge, where the two modes of life came in contact. Sir Thomas speaks of his liking for the desert, especially the Eastern Desert, with its opportunities for sport and adventure, though things are not the way they used to be; wild life, for example, has suffered from the cutting down of the acacia thickets, stimulated by the demand for charcoal during the First World War.

Experience in the country districts proved a valuable prelude to service in Alexandria and in Cairo, where in 1918 Sir Thomas was promoted to the important post of Commandant of Police. The activities of a policeman in so cosmopolitan a city perforce are highly varied. One of the most interesting features of his metropolitan career, and one with many geographical implications, was the fight against the drug traffic, a fight made more difficult in the earlier stage by the "nightmare" of capitulations (abolished in 1937). The story of the smuggling of hashish from Greece into Cyrenaican ports and its conveyance by Arab caravan across the Western Desert is fascinating; so too is the account of the "tricks of the trade," in which the camel, externally and internally, played a star role.

WEATHER FORECASTING IN TROPICAL REGIONS. By A. G. FORSDYKE. 47 pp.; maps, diagrs., bibliogr. *Gt. Brit. Meteorol. Office Geophys. Memoirs No. 82*, 1949. 2s. 6d. 11 x 8 inches.

This memoir consists mainly of a general commentary on some problems of weather forecasting in tropical regions as they appeared to the author before May, 1946. Unfortunately, it is based almost solely on the author's experience with the meteorology of East Africa and the western Indian Ocean, where conditions are not typical of tropical regions, and where little progress has been made in map analysis and forecasting.

The discussion is divided into five parts. Part I, "Tropical Forecasting in General," outlines the use made of weather forecasts in the tropics by aviation, shipping, and agricultural interests and the general public. Part II, "Relation between Wind and Pressure Distribution," reviews the well-known equations of motion, the modification of the geostrophic wind equation in low latitudes, and other pressure-wind relationships in these latitudes. The results are of no practical value for forecasting in tropical regions, since the assumptions are not generally applicable. The importance of the field of horizontal divergence is discussed in relation to precipitation and cloudiness. A mapping technique is suggested for calculation of the field of horizontal divergence from the observed winds aloft, but no comments are made as to how such maps can be used in forecasting, i.e. movement and changes of the field of divergence.

Part III, "Upper Air and Convective Phenomena," consists of a few brief notes on upper-air temperature, pressure, and moisture conditions and convective phenomena in Africa, India, and the western Indian Ocean. Many forecasters who had wartime experience in Africa will not agree with the author regarding the usefulness of the tephigram for local forecasting; most found the tephigram an extremely unreliable tool. Though considerable more information is available regarding upper-air conditions and convective phenomena than is contained in these three pages, the meager notes emphasize our lack of knowledge of upper-air conditions in the tropics and the need for greater use of upper-air data for map analysis and forecasting in low latitudes.

Part IV is a cursory discussion of some of the observed and theoretical features of "Frontal Zones and Discontinuities [and] Tropical Storms" and the map analysis and forecasting

techniques pertaining to them. The discussion is decidedly incomplete, and there are many questionable statements. The author does make one contribution, however; he confirms that the synoptic patterns and weather sequences noted in the tropics of the Western Hemisphere and in the western Pacific Ocean also occur, somewhat modified as one would suspect, in East Africa and the western Indian Ocean.

Part V, the conclusion, contains a list of some problems for investigation and some suggestions regarding forecasting techniques.

It is unfortunate that publication of the memoir was delayed until 1949, three years after it was prepared, and that it has not been revised. So much progress has been made in tropical meteorology that most of the comments are of only historical value. The time factor and others mentioned above suggest that the memoir is not of as much use to the geographer as the title would lead one to believe. Geographers seeking the latest information on forecasting in the tropics would do better to consult "Tropical Meteorology," *AAF Manual 105-2*, Headquarters, Army Air Forces, May, 1945; "Handbook of Meteorology," edited by F. A. Berry, Jr., E. Bollay, and Norman R. Beers, New York and London (McGraw-Hill), 1945; various reports by Herbert Riehl and G. P. Cressman in the *Miscellaneous Reports* of the Department of Meteorology, University of Chicago; and scattered literature in American, British, and New Zealand meteorological publications.—LEO ALPERT

L'AFRIQUE BLANCHE FRANÇAISE. Volume I, L'Afrique du Nord. By JEAN DESPOIS. xvi and 624 pp.; maps, diagrs., ill., bibliogr., index. (Colonies et Empires, 4th Ser., Géographie de l'Union Française, Vol. I.) Presses Universitaires de France, Paris, 1949. 900 fr. 9 x 5 $\frac{1}{2}$ inches.

In the foreword to "L'Afrique du Nord" Professor Jean Dresch remarks that the average citizen of France knows little about foreign lands in general and even less about the lands which make up the French Union. He adds that, although there are many ranking works on the various parts of the Union, they are all works for specialists and therefore do not perform the function, so significant since World War II, of educating the average citizen. The task undertaken by the series "Géographie de l'Union Française," which is under the particular direction of Professor Dresch, is to create a real understanding of the overseas parts of the Union "in a spirit stripped as completely as possible of all colonialist tendency."

Professor Jean Despois, of the Faculty of Letters of Algiers, is eminently well equipped to carry out this task in a workmanlike fashion, as his books on Tunisia, Tripolitania, Libya, and the Sahara testify. In "L'Afrique du Nord" he is dealing with a region and with people he knows and understands.

"The principal object of this book," he states in the introduction, "is to study the geographic consequences of contact between two civilizations very different in their aspirations and in their techniques." To this aim he adheres strictly. The facts, both physical and cultural, are presented admirably; the conclusions are reached with precise logic; and all parts of the book tie back to the theme so concisely stated in the introduction.

As Despois defines North Africa it is synonymous with the Atlas lands—Algeria, Tunisia, and Morocco. He emphasizes the essential physical unity of the region, though he reiterates that it is a unity of repetition rather than of monotony. On the other hand, he points out, there has been no unifying force so far as the human element is concerned. Likewise, no real integration of human activity with the land existed before the coming of the French.

Slowly, however, a rational readjustment is leading toward an economic, if not a cultural, unity.

The book is divided into five parts. The first is entitled "The Natural Conditions." Climate, landforms, vegetation, and soil are treated systematically, and a concluding chapter outlines natural regions and discusses agricultural limits and possibilities. In the second part, "The Human Conditions," chapters on foreign influences, Berber society and Moslem influence, and the French in North Africa lead to a summary statement of the nature of the present-day population. Part 3 analyzes the evolution of native economies. Part 4, the longest, is a detailed examination of "The Work of Colonization." Here the chapter headings reflect the intensity with which the author has treated this topic: Rural Colonization; Agricultural Production—Economic and Social Problems—Forests; Mineral Wealth and Sources of Energy; Industries—Fishing; and Transportation and Trade. The final part comprises a chapter each on Algeria, Tunisia, and Morocco and a general conclusion. Thus the treatment constantly stresses French North Africa as a whole; only at the end is there a departure from that position to suggest that the main differences between the parts of the region are matters of degree. The text is amply footnoted, and there is a well-chosen 46-page bibliography. The accompanying maps leave much to be desired, except for three fold-ins. Of these, particular attention should be called to one showing native economies. It is unfortunate that there are no population distribution or density maps on the same scale.

In a work of this kind it is not to be expected that any considerable body of new factual material will be included. It is rather in the choice of facts, their presentation, and their interpretation that contribution can be made. Professor Despois has left no doubt of his ability along these lines. He has created a remarkably clear picture of the land, its people, and the problems of readjustment that are to be faced by French North Africa in the present-day world. Above all else, he has emphasized the significance of cultural impact. His reasoned account leaves the impression of continuing, even accelerating, change as the keynote of the region.

Five series are projected in the collection of postwar works "Colonies et Empires" appearing under the general direction of Ch.-André Julien: (1) Colonial Studies; (2) The Classics of Colonization; (3) History of French Expansion and Colonization; (4) Geography of the French Union; and (5) Art and Literature.—HENRY MADISON KENDALL

A WORD GEOGRAPHY OF THE EASTERN UNITED STATES. By HANS KURATH.
xi and 88 pp. of text and glossary; 163 map plates. (Studies in American English, 1.)
University of Michigan Press, 1949. \$4.00. 11¼ x 8½ inches.

At dusk in the pastures of New England, New York, and northern Pennsylvania you will hear the call *Boss!* or *Bossie!* or *Co-boss!* or perhaps *Come bossie!* Go into southern Pennsylvania, or West Virginia, or the western parts of Virginia and North Carolina, and it will be *Sook!* or maybe *Sookie!* or even *Sook cow!* Then travel into almost any section of the Piedmont or Coastal Plain from Delaware Bay to Georgia, and the call will be *Co-ee!* or *Co-wench!* or *Co-inch!*

All this you may discover from two maps in this book. Little circles and triangles on Figure 99 indicate where these various calls are used—and there are also maps for the summoning of calves, chickens, and pigs and the acceleration and deceleration of horses (*Go on! Hoa!* etc.; *Get up!* and *Woa!* are more or less general and hence are not mapped). On Figure

15 a broken black line shows the eastern boundary of the area within which cows respond to *Sook!* or variants thereof. Dr. Kurath designates such a boundary as an "isogloss." On Figure 15, along with the *Sook!* isogloss, he has drawn similar lines for *I want off* (i.e. "I want to get off") and *snake feeder* (i.e. "dragonfly"). They all follow much the same general course.

By examining these and many other isoglosses, Dr. Kurath prepared a generalized map of the word geography of the eastern United States. It reveals three major and 18 minor areas. The major areas are the North, the Midland, and the South, which approximate the *Co-boss!* the *Sook!* and the *Co-wench!* domains respectively. Kurath maintains that "the common notion of a linguistic Mason and Dixon's Line separating 'Northern' from 'Southern' speech is simply due to an erroneous inference from an oversimplified version of the political history of the nineteenth century." The establishment of a Midland area is the most important result of the investigations on which his book is based. "This Midland area . . . is linguistically distinct from the Northern and the Southern areas and is in part set off by sharp boundaries." Its northern border cuts diagonally northwestward across the middle of New Jersey and then westward through north-central Pennsylvania; its southern begins on the west shore of Delaware Bay, swings in a broad arc around the head of Chesapeake Bay and Washington, and follows the Blue Ridge southward. The physiographic provinces of the Great Valley, the Folded Appalachians, and the Appalachian Plateaus belong wholly in the Midland area. It was settled largely by migrants from eastern and southern Pennsylvania.

The data were collected in connection with the project for a "Linguistic Atlas of the United States and Canada," which was begun in 1931 under Dr. Kurath's direction and of which the first fruits were the monumental "Linguistic Atlas of New England" (3 vols. [in 6], Brown University, Providence, R. I., 1939-1943) and its accompanying "Handbook of the Linguistic Geography of New England" (Brown University, 1939). "In the *Atlas* survey, nearly every county in the Eastern States is represented by two speakers, one old-fashioned and unschooled, the other a member of the middle class who has had the benefit of a grade-school or high-school education. In addition, most of the larger cities are represented by one or more cultured persons." Thus the three forms of our language—*folk speech*, which tends to preserve local and regional peculiarities; *common speech*, which also does so, though to a smaller extent; and *cultivated speech*, more or less uniform throughout the nation—are all reflected in the study.

The volume opens with a general survey of the historical and social factors that have determined the geographical patterns of speech. The "regional types of American English," which were brought over from the Old World and were first planted near the seaboard, "spread inland as the settlements expanded up the rivers and across the mountains, and they were blended anew when settlers from different colonies mingled on the frontier. There can be no doubting the fact that the major speech areas of the Eastern States coincide in the main with settlement areas and that the most prominent speech boundaries run along the seams of these settlement areas." The two principal chapters deal, respectively, with the several speech areas, as determined by characteristic words, and with the regional and local vocabulary as "arranged from the point of view of meaning." In the latter chapter it is shown, for example, that *dragon fly* is "largely a book word in the Eastern States, and as such it has gained a foothold in urbanized areas from Boston to Baltimore." The usual

terms are *darning needle*, *snake feeder*, *snake doctor*, and *mosquito hawk*, and the distribution of each of these is explained in considerable detail. Of the 163 clean-cut maps, 41 show isoglosses for words having different meanings but similar distributions, and 120 show by point symbols the distribution of different words of which the meanings are the same. Unlike the "Linguistic Atlas of New England," this volume does not go into the question of pronunciation, though the author asserts that "features of pronunciation and of grammar seem to exhibit regional distributions that resemble the dissemination of words very closely."

AN ECONOMIC GEOGRAPHY OF GREAT BRITAIN. By WILFRED SMITH. xv and 747 pp.; maps, diags., index. Methuen & Co. Ltd., London, 1949. 32s. 6d. $8\frac{3}{4} \times 5\frac{1}{2}$ inches.

All too often geographers establish the correlations between economic activities and the elements of the natural environment but give inadequate attention to the other forces that have played or are playing equally important roles in the shaping of local and regional economic development. The underlying concept of Mr. Smith's scholarly book is that economic geography is "one facet of the whole geographical complex, its special field being the analysis of the distribution forms or patterns of economic life"—patterns that display varying degrees of adjustment to the complex of physical, economic, technical, cultural, historical, and political circumstances under which they have evolved. The author's analysis of the local and regional economy of Great Britain shows clearly that he is as thoroughly conversant with the basic concepts of economics and history as with those of geography.

Mr. Smith rightly assumes that economic geography is dynamic, that it is constantly changing as economic, technological, and political factors change, and that overemphasis on the physical foundation leads to faulty conclusions. In Part I he describes how the medieval economy developed, how it was transformed, and how the modern economy took shape. He draws heavily on those facets of economic history which explain, in part, the course of Britain's economic development. At the same time he does not neglect the contributing physical factors. This detailed discussion of the evolution of agriculture, industry, and trade and transport provides a rich background for Part II.

The much longer second part is devoted to a systematic analysis of the present economic geography. The author deals principally with the long-term aspects of the economy as it existed immediately before World War II. The readjustments made to meet the wartime emergency and the postwar controls he regards as "short-term situations superimposed on these long-term trends, though they may in the end prove here and there to have long-term effects."

Mr. Smith does not cover all the ground the title of his book suggests. Some phases of the economy, such as agriculture, coal mining, iron and steel, textiles, and foreign trade, receive detailed treatment; others, such as the chemical, pottery, plastic, fishery, and forest industries, are given relatively scant attention. The author assumes that his reader possesses a fair knowledge of the basic geography of Great Britain, and particularly of its physical characteristics; consequently he does not supply background information available in more general geographic works. Of necessity his regional illustrations are selective, since "Great Britain presents . . . such an infinitely varied rural and urban landscape, laboriously and meticulously created by centuries of human labour working on an already rich diversity of physical terrain, that a single individual cannot be equally familiar with the whole of such a complex panorama."

The book is extensively documented, and the text is supplemented by well-arranged statistical tables. The many maps, though small, are clear and designed to serve specific purposes. They are, in large part, constructed on a county base. To readers unfamiliar with Great Britain's county system the lack of a key map will be a handicap.—JOHN B. APPLETON

DE LA FLORIDA A SAN FRANCISCO: Los exploradores españoles en los Estados Unidos. By F. GONZÁLEZ RUIZ. 452 pp.; maps, ills., bibliogrs. Ibero-Americana, Buenos Aires, 1949. \$6.00. 11½ x 8 inches.

European civilization came into the area of the United States from the south, borne on the sword points of the Spanish conquistadors. In this work Dr. González Ruiz attempts a general survey of the achievements of these men and of the varied terrain through which they traveled.

Five areas in turn engaged the interest of the explorers, and five main sections of the book reflect this changing interest: Florida, "Land of Perdition"; In the Deserts of the South, The Father of Waters; The Grand Canyon of the Colorado; and The Founding of San Francisco.

In a short preface the author calls attention to the centuries-long blindness of the believers in the "black legend" of Spanish cruelty and Spanish greed. He notes the missionary zeal of many of the conquistadors and their possession of the true spirit of exploration that sent them questing *más allá*—ever farther into the blank spaces on the map.

From the islands Ponce de León led the way into the continental part of the later United States. From such sources as are available, a fair description of the hazards facing the invaders is given. This was the period of beginnings, with Ponce de León in Florida, Cortez preparing bases for scores of future expeditions by his Mexican conquests, Pánfilo de Narváez opening up the Gulf, Sebastián Vizcaíno charting the Pacific coast, Nuño de Guzmán seeking new kingdoms to the west, and incidentally succoring the transcontinental pedestrian Álar Núñez Cabeza de Vaca. It was a time of almost incredible achievement, which demands considerable restraint from any author, Latin or Anglo-Saxon. Dr. González Ruiz manages to keep his enthusiasm under control without smothering it. He points up the civilizing attainments of Cortez, Pizarro, and Balboa, using the near-contemporaneous activities of Drake, Hawkins, and Raleigh as a form of counterpoint.

We move on now to the deserts of the south and the wanderings of Cabeza de Vaca, which are considered in some detail. The author believes it unlikely that the route can ever be traced with accuracy but feels it probable that the path of the intrepid soldier and his companions may have roughly paralleled the present line of the Southern Pacific railroad. Whether they passed through New Mexico and Arizona, or through Chihuahua and Sonora, the terrain was much the same.

In this part we also find a restrained and yet thorough treatment of the various theories that attempt to account for the origin of the American Indian. Dr. González Ruiz even notes, though with skepticism, the work of the Argentine scholar Ameghino, who sought to establish the great antiquity of man in the Plata region. Most of the available material relating to the aboriginal occupants of the hemisphere has come, of course, from the pens of the Spanish valiants.

Something of the explorations of Coronado is presented here, more in a later section. Coronado is termed the greatest of all the explorers of North America, a man who covered

more than 10,000 English miles. Fray Marcos de Niza receives a chapter, and a relatively elaborate description is given of the various Pueblo Indians.

The scene then shifts to the Mississippi Valley and Hernando de Soto, who led one of the best prepared of all the early expeditions into the region of the southern United States. The story is a dramatic one, even though not crowned with the gold and gore of Cortez and Pizarro.

The section on the Grand Canyon of the Colorado returns to the exploits of Coronado, and also to later leaders—Francisco Sánchez de Chamuscado, Antonio de Espejo, and Juan de Oñate. The terrifying assault on Acoma, one of the most thrilling episodes of the Conquest, is given careful and artistic attention. The fifth section, although titled "The Founding of San Francisco," describes the work of Junípero Serra in California, an area that Dr. González Ruiz, with some reason, considers to be still the most Hispanic in the United States. In the concluding chapter the author offers an unusual survey of North Americans who have written extensively of things Hispanic and Hispanic American. His observations on Irving and Prescott are penetrating and unbiased. Such writers as Bolton and Priestley, however, might well have been included, and their works consulted.

The book as a whole has been carefully planned to avoid ostentatious flourishing of the mechanism of scholarship. After each of the five parts is a brief, and not wholly satisfactory, bibliographical section. The various and frequent references to the United States are extremely fair and will present an unusually pleasing vista to Spanish and Spanish American readers. There is far more honest appreciation of mutual inheritance than is customary.

Most of the errors noted are typographical and could easily be corrected in later editions. A little more consistency in the rendition of North American place names would be desirable, but neither the "Pand Handle" nor the "Band Lands" offers much difficulty. A reference to "Fray" Vásquez de Coronado may have produced a rapid rotary movement in the interior of that explorer's tomb. Gálvez never, in available documents, wrote his name "Galve," nor did the viceroy Calleja use the form "Callejas."

The excellent illustrations alternate Arístizábal's imaginative portraits with photographs of various areas in the regions described. The two maps are merely sketches. All in all, the book is a fine one for Spaniards and Spanish Americans beginning their studies of the United States. In translation, it might prove equally valuable in reminding North Americans of a neglected part of their heritage.—ROBERT BENAWAY BROWN

BIOGEOGRAPHY OF THE PLEISTOCENE. Part I, Europe and North America. By EDWARD S. DEEVEY, JR. Maps, diags., bibliogr. *Bull. Geol. Soc. of America*, Vol. 60, 1949, pp. 1315-1416.

In June, 1947, the Division of Geology and Geography of the National Research Council set up a Committee on Interrelations of Pleistocene Research, with Professor Richard Foster Flint as chairman. The group's first task was stocktaking, and to this end the members have summarized the significant information and literature of their particular fields in a symposium published in the *Bulletin of the Geological Society of America*. Dr. Deevey's paper on biogeography constitutes almost half of the symposium. It is the first part of three; one hopes that the others will soon be forthcoming.

Part I consists of an introduction and two sections dealing with the Pleistocene biogeography of Europe and North America respectively. The introduction is a statement of

principles, and from the very beginning one feels the sharp breeze that sweeps out the musty cobwebs of antiquated ideas. The initial tempo is maintained throughout, which is refreshing and satisfying.

The section on Europe deals mainly with three aspects—the last glaciation and after, Pleistocene biogeography of Central Europe, and the British Isles. West of the Atlantic, the author concerns himself with Pleistocene and postglacial stratigraphy, and with Pleistocene and later aspects of the southeastern United States, eastern North America, and western North America. There is a recurring emphasis on the important maxim that the age of a distribution pattern is not necessarily the same as the age of a species; in fact, no distribution is taken to be old unless it can be proved not to be young. This is a healthy point of view, which permits avoidance of much unwarranted speculation. The paper concludes with remarks on the limitations and value of biogeography as a science. It must be remembered, however, that these remarks refer only to Pleistocene problems; biogeographical data find a great variety of applications if they refer to our own time, whereas the list of “values” given by Deevey is extremely brief.

It is inevitable that in dealing with such large regions and such remote times the author should encounter many theories and hypotheses. At no time does he leave the reader in doubt as to his own opinion. He is tactful but also merciless in his destruction of every idea that does not meet his critical, logical, and rigorous demands. Thus many a time-hallowed thesis is swept overboard, or at least modified sufficiently to stand up under the onslaught of new evidence gathered and coordinated by a keen and vigorous mind. There is no doubt that Dr. Deevey's clear thinking has contributed materially to the entire field of Pleistocene biogeography. But he is quite human too and eagerly jumps at an argument if it can be used in support of one of his own ideas, and he often relies heavily on other scientists' judgment, apparently with complete and unquestioning confidence (for example, Mayr or Cain). And he is full of praise for some achievements—Hobbs's work in the Great Basin, for instance.

It is to be hoped that this summary will be read by many geologists, geographers, and stratigraphers. Again and again, as one proceeds through the wealth of material presented here, one is struck by the incredible lack of adequate stratigraphic data. Only in Europe have significant advances been made; elsewhere the stratigraphic work on the Pleistocene is at least a generation behind.

The paper is well illustrated with tables, maps, and diagrams, generally not original. Figure 10 is so poorly redrawn from an excellent map by Franz as to be confusing, but the other illustrations are satisfactory. The reader will especially welcome the tables in which the stages of the Pleistocene and the postglacial period of various regions are coordinated biogeographically. The bibliography is well selected and helpful, considering the enormous amount of published material.

For several decades it has been recognized that the geographical distribution of organisms has undergone great changes in the course of time and that the present distribution is largely the result of the repeated advances of continental ice sheets and their effects. It seems obvious, then, that the Pleistocene glaciation is one of the main keys to modern biogeography, and geographers will be grateful to Dr. Deevey for his fine contribution. There has been great need for an adequate summary, and “Biogeography of the Pleistocene” fills this need. It should not be absent from the files of anyone interested in the Pleistocene or in biogeography.—A. W. KÜCHLER

JAPANESE PREWAR TRADE AND SHIPPING IN THE ORIENTAL TRIANGLE.

By NORTON SYDNEY GINSBURG. xii and 308 pp.; maps, bibliogr. (Dissertation, Ph.D., University of Chicago; also as *Univ. of Chicago Dept. of Geography Research Paper No. 6.*) Chicago, 1949. 9¼ x 6 inches.

This geographic investigation and analysis of Japan's prewar trade in the "Oriental Triangle" is an important addition to recent studies of the Japanese economy. Emphasis is placed on the areal pattern of the trade as expressed in shipping facilities and performance.

The "Oriental Triangle," with apexes at Kamchatka, northwest India, and New Zealand, predominated in Japan's prewar trade. More than 60 per cent by value of the overseas trade was with the Triangle countries, and the percentage by volume was much higher. The shipping that serviced this trade was dominated by vessels owned or chartered by Japanese companies.

The study falls into three parts. Introductory chapters explain the scope and method of the investigation and survey the overseas trade and shipping of prewar Japan. The body of the book is devoted to a detailed description and analysis, country by country, of the trade and shipping in East Asia, Southeast Asia, Indian waters, and Australian waters in 1936.

Among the salient points brought out are the following:

1. Japan's prewar merchandise trade was roughly balanced in value, but poorly balanced in weight, the tonnage of imports being more than three times that of exports.
2. Within the general pattern of the trade (imports of bulky raw materials, food, and some semimanufactures in exchange for manufactured and semimanufactured goods), East Asia and Southeast Asia were of particular importance in supplying heavy, bulky cargoes.
3. The United States was relatively unimportant in the prewar import trade. (This is in sharp contrast with the early postwar trade, in which the United States has been a major supplier.)
4. Although the Oriental Triangle predominated in the trade, many of its countries were tied in various ways to industrial nations of the West. The Philippines, for example, had strong ties with the United States, the Netherlands Indies with the Netherlands; and Malaya, India, Australia, and other countries were parts of the British Commonwealth.
5. The outlook for trade in the near future between Japan and Southeast Asia (including the prewar areas of Siam, French Indochina, British Malaya, the Netherlands Indies, and British Borneo) is promising, and the encouragement of rapid re-establishment of Japanese trade relations with this region is indicated as desirable.
6. Although Japan exported large quantities of textiles to India before the war, the rapid expansion of India's textile industries will limit this trade in the future.

In a brief concluding chapter, "Policies toward a Japanese Merchant Marine," a 1948 Japanese government report on shipping is described, and then Mr. Ginsburg suggests a revision of the proposals, on the basis of his study of shipping needs in relation to the prewar trade. It is his opinion that if Japan is to be an important manufacturing and trading area of East Asia, she will need as a minimum requirement a merchant fleet of 2,150,000 gross tons of ships over 1000 gross tons. Of this total, 1,900,000 tons will be needed for the import trade and 250,000 tons for the coastwise trade. The aggregate gross tonnage of the reconstituted merchant fleet, including ships between 100 and 1000 tons, should be "a little more than 3,000,000 tons." This is only slightly more than the tonnage owned in 1920 and about 53 per cent of the 1939 tonnage.

The book includes a series of maps showing the areal concentration of Japanese shipping within the Triangle; there is also a useful bibliography. To this reviewer it is noteworthy that Mr. Ginsburg's study, unlike so many, is pointed toward the solution of a current problem.—ADA V. ESPENSHADE

DREDGE, DRAIN, RECLAIM! The Art of a Nation. By JOH. VAN VEEN. 2nd edit. 165 pp.; maps, diagrs., ills. Martinus Nijhoff, The Hague, 1949. Gld. 12.—. 10¼ x 7¼ inches.

Even at the risk of being accused of excessive patriotic enthusiasm, I must say that the reading of this book was a sheer delight. It is the story of the Dutch battle against the water written by an expert—simple but complete, with enough details to please even the professional geographer, and beautifully illustrated with excellent colored maps, drawings, and well-chosen photographs.

If much of the clear, well-organized material is familiar, much is still new to most geographers. The book might be described as a story of reclamation, how it was done in earlier times and how it is done now, including, for instance, the reconquest of the land of Walcheren, flooded by the Allies during the liberation of the outlet of the Schelde, when the harbor of Antwerp had to be made available for Allied shipping to prepare for the final drive into Germany. It points with pride to the two shipping canals of Rotterdam (New Waterway) and Amsterdam (the North Sea Canal), with the world's biggest lock at Ymuiden. Particular attention is given to the Dutch specialty of dredging, which has been carried on all over the world from the Caribbean to the coast of China—the extension of the harbor of Cape Town, started in 1938, is an interesting example—and from early times to the present.

Besides describing the triumphs of modern techniques, the book discusses problems that still face the engineer, such as the subsidence of the land, the rotting of foundation piles, salt infiltration, and subterranean sea-water activity.—S. VAN VALKENBURG

POPULATION TRANSFERS IN ASIA. By JOSEPH B. SCHECHTMAN. viii and 149 pp.; maps, bibliogr., index. Hallsby Press, New York, 1949. \$1.50. 8½ x 5½ inches.

This volume is primarily concerned with advocating population transfer as the only practicable solution of the Israeli-Arab conflict. A chapter is devoted to the Hindu-Moslem clashes arising from the partition of India, and another recounts the plan to gather Armenians into the Soviet Armenian Republic, and also plans to transplant Assyrian Christians from Iraq. But there have been many other recent population transfers in Asia—in Korea, Burma, Indonesia, Manchuria, and elsewhere. This book is not a survey of Asiatic population problems. What Mr. Schechtman is interested in is the case for uprooting minorities in politically difficult areas, so that politically (or religiously) homogeneous states may be organized. In his words: "If a country, or two countries, or an international body is faced with a minority problem which manifestly cannot be solved within the existing territorial framework and which, if perpetuated, will obviously lead to international complications and possibly to war, recourse should be taken at once to the preventive device of transfer."

His Armenian, Assyrian, and Indian examples seem inconclusive. It is not surprising that "the repatriation movement initiated by the Armenian national organizations in 1945 was therefore organically linked with demands for the territorial expansion of Soviet Armenia"—expansion into strategically important areas of Turkey. In India, "over eleven

million people have been transferred, but there are still about thirty-five million Moslems in the Dominion of India and some thirteen million Hindus and Sikhs in the Dominion of Pakistan (almost exclusively in East Pakistan)." Evidently a big transfer job remains—if transfer is the answer to minority problems.

It can hardly be argued, and the author is careful not to argue, that this device of importing minorities to achieve religious, racial, and cultural homogeneity is generally desirable. If it is, the experiment of these United States was based on wrong principles. There is something to be said for persuading people to get along together and to keep their tribal and sectarian feelings within bounds. As a last resort in embittered situations, it may be necessary to use the surgery of deportation—which is what Mr. Schechtman really means by transfer. But, aside from the feelings of the deportees, this is dangerous. The Burmese "transferred" Indian moneylenders, and the Indonesians "transferred" Chinese middlemen, with much damage to their own economies.

The argument of this book is that Palestine "seems a classic case for quick, decisive transfer action as the only constructive method of solving the basic problem and preventing extremely dangerous developments." This may now be true. There are several hundred thousand Arab refugees scattered over neighboring states. Mr. Schechtman recounts the Israeli version of how this happened; but whatever the causes of the tragedy, they are now refugees, and however they feel about losing their homes, they are not likely to get them back. Resettlement mainly in Iraq—and withdrawal of Jewish minorities from surrounding Arab countries—may be the best, and perhaps the only, solution. It may be true that just before Britain relinquished the Palestine mandate the Arabs were a considerable majority; but it is also true that they lost a sharp war and are now homeless, and mostly indigent, refugees. This is not the first time such events have occurred in this corridor of history. It may not be the last. If the world's conscience, and its technology, could create a modern Arab economy and a modern Israel and persuade them to keep the peace and cooperate, political stability and economic prosperity might be assured. But it is easier to create refugees than it is to settle them.—J. B. CONDLIFFE

THE COUNCIL OF THE SOCIETY: AN APPEAL

SINCE the Society was founded, nearly a hundred years ago, 213 men have served on its Council, the governing board that guides its course and policies. The accompanying list has been prepared by Dr. John K. Wright, who is writing a history of the Society; it probably includes all those who have been elected to the board (among them three who did not serve). The reader is invited to look through it and to communicate with Dr. Wright (at the Society) should he run across names of forebears or others of whom he may have knowledge. References to biographical notices and information concerning diaries, collections of old letters, and so on would be helpful indeed. Stars are placed after the names of several of the most active and influential Councilors about whom no adequate biographical data have yet been found and for whom information would be especially welcome.

From the beginning men of high distinction have been elected to the Council. Among the statesmen and politicians who have been members were John C. Frémont, Horatio Seymour, Levi P. Morton, Franklin D. Roosevelt, Frank L. Polk, Frederic C. Walcott; among the diplomats, George Folsom, George Bancroft, Townshend Harris, Whitelaw Reid; among the Army officers, Generals E. H. Vielé, G. W. Cullum, and F. R. McCoy; among the Navy officers, Admirals C. H. Baldwin, F. E. Chadwick, and Bancroft Gherardi. Bankers, merchants, manufacturers, and other wealthy patrons of the arts and sciences have been represented in Henry Grinnell, August Belmont, D. O. Mills, Morris K. Jesup, Otto Kahn, Paul Warburg, Archer M. Huntington, James B. Ford, Arthur Curtiss James, Charles R. Crane; judges, in A. W. Bradford, Charles P. Daly, W. E. Curtis; university presidents in Seth Low, John Finley, Isaiah Bowman, Charles Seymour; publishers and editors, in H. J. Raymond, Charles A. Dana, G. P. Putnam, Henry Holt. During the first 50 years, when interest in missionary enterprise ran high, there were at least eight clergymen on the board, notably Doctors Roswell D. Hitchcock and Philip Schaff. Explorers have included I. I. Hayes, Paul du Chaillu, Robert E. Peary, Alexander Hamilton Rice, Lincoln Ellsworth; scientists, Matthew Fontaine Maury and Alexander Dallas Bache in oceanography, J. C. Le Conte in entomology; A. A. Julien, Clarence King, and J. H. Hague in geology, Robert Cushman Murphy in ornithology, A. H. Guyot, William Libbey, Isaiah Bowman in geography. In the field of historical, literary, and legal scholarship there have been such men as George Bancroft, J. Carson Brevoort, J. R. Brodhead, Archer M. Huntington.

Birth and death dates are given where it has been possible to determine them from readily accessible sources. Queried birth dates have been inferred from such statements as "Mr. X died in 1897 at the age of 87." A few of the dates of service, particularly during the earlier period, may be a year or two in error. The date of termination of service in one capacity is not given when service in another capacity followed immediately.

/ absence from the Council between two periods of membership.

n elected, but did not serve.

C Councilor not holding one of the following offices:

P President	T Treasurer	F Foreign Corresponding Secretary
HP Honorary President	L Librarian (a Council member until 1873)	D Domestic Corresponding Secretary
V Vice-President	R Recording Secretary	AR Assistant Recording Secretary

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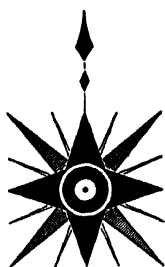
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World Geography of Petroleum

AT the end of October the Society's cooperative volume on the "World Geography of Petroleum" will be off the press. This new book, brought forth in the shadow of war, deals in a new way with an instrument of power vital alike in peace and war. Here for the first time are outlined in systematic fashion fundamental geographic aspects—aspects heretofore neglected amid the wealth of studies on the chemistry, geology, finance, or romance associated with prospecting for oil. We conceive the book to be a contribution of major importance and announce its imminent publication with pardonable pride.

The Society has long had an interest in the geography of oil and had hoped at one time to publish some of the researches of the late Frederick G. Clapp, the eminent petroleum geologist who worked for many years in Iran and other areas of the Middle East. The idea for the present book originated in 1945 with two members of the Council, Thomas W. Palmer and the late Philip W. Henry, both of whom had followed the exploratory activities of the industry in Latin America at first hand over many years. In fact, Mr. Henry, whose life span closely paralleled that of the industry, was a pioneer in the extraction of asphalt from its natural reservoir on the island of Trinidad. On their advice, the Society turned to Mr. Wallace E. Pratt to be consulting editor and part author of the volume, and the choice could not have been happier. Mr. Pratt combines a long and successful experience in oil prospecting with the immense optimism that has characterized—and, indeed, governed—the spectacular growth of this incredible industry. In May of this year he was awarded the James Furman Kemp medal for distinguished service in geology by the faculty of Columbia University. Anyone who is inclined to question Mr. Pratt's forecasts needs only to go back to his prophetic lectures delivered to geology students at the University of Kansas in 1941 and read them in the light of the events of the intervening years.

The twenty contributors bring to the work a wide variety of talent and

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viewpoint. Though the majority are geologists, others are men whose careers lie in the fields of economics, management, marketing, and military affairs, for the penetration of the petroleum industry is of gigantic reach. The impact of the book is that of a direct thrust from the world of industrial activity—thorough, competent, and fresh.

The difficulties inherent in original and authoritative multiple-authorship volumes must be experienced to be appreciated, and for obvious reasons not many such books are undertaken. It is perhaps appropriate, therefore, to draw attention here to two of the Society's earlier volumes of this type, "Pioneer Settlement" (1932) by twenty-six authors, and "Problems of Polar Research" (1928), by thirty-one authors. These works set forth in symposium form the best that could be drawn in all the relevant fields from the leaders of the day. Consider, for example, the value of comparative studies in pioneering zones from Manchuria to Patagonia, from French North Africa to Rhodesia, from the Canadian Northwest to Australia's Northern Territory. Recall what meaningful association goes with the names of Nansen, Rasmussen, Stefansson, and Mawson; Wilkins, Ellsworth, Byrd, and Bartlett; and then fit into a mosaic the studied observations of their ripening years joined integrally with the works of experts such as Marmer on tides, Murphy on ocean life, and Miller on air navigation, to portray the true nature of the Polar Regions.

We feel that the Society is particularly well placed to publish works of this character: first, because of the continuity made possible by our full-time editorial staff, one or more of whom can be assigned to see such a volume through to its completion; second, because of the incalculable aid of our extensive geographical library and map collection; and third, because of the group of experienced cartographers who make possible the employment of maps without stint and the tailoring of each map to its subject.

The petroleum book is handsomely supplied with illustrative matter in the way of maps, diagrams, and photographs; many of the large oil companies have collaborated in furnishing the source materials. The maps are of several kinds. Maps of large areas show broad physical distributions of sedimentary oil basins and the oil fields within them—over the world, in North America, in the Arctic, and in Europe—and of the continental shelves. There are location maps of primary petroleum regions, such as the Middle East and the Caribbean, that illuminate the elements of topography, transport, and culture described in the text. Again, there is an unusual map that shows in detail the layout of wells and operational facilities in a single giant field, Burgan in Kuwait, and makes clear the kind of planning and of

adaptation to natural circumstance that were necessary. In another type of map, industrial distributions are shown—oil transport and refining facilities in the Soviet Union, the Middle East, and North America. Still others show statistical distributions; for example, the chief types of petroleum used per capita in each country in 1938.

The industrial history of petroleum in America dates only from 1859, when Colonel Drake drilled the first well near Titusville, Pennsylvania. The past century has been one of accelerating understanding in the realm of oil technology; mankind has probed the opportunities inherent in this most versatile of fuels, especially since the discovery of the internal-combustion engine, has learned the vagaries of the substance and some of its limitations, has explored its potentialities in the field of chemistry, and has come to respect its magnificent flexibility—for the needs of power, for industry, defense, and the implementation of human welfare in countless ways.

RICHARD U. LIGHT

Combined Operations

"When was ever honey made with one bee in the hive?" asked Thomas Hood a century or more ago. It is a question particularly apposite in the light of the appreciative acknowledgments that accompany every article in our present issue. "The author wishes to express his gratitude to . . .," "through funds generously provided by . . .," "made possible through the assistance of . . ."—these are phrases that occur again and again in the pages of the *Review*, and behind them lies a satisfying story of cooperation between individuals and agencies, both official and private, or collaboration between scientists in different countries and in different disciplines.

Our first two articles provide examples of a particular kind of cooperative enterprise—the calling in of specialists from abroad for assistance to government-sponsored agencies. Professor Waibel's long interest in settlement problems (as evidenced, for instance, in his paper on "White Settlement in Costa Rica" in the *Geographical Review* for October, 1939) led to his being called from the faculty of the University of Wisconsin to act as consultant to the Conselho Nacional de Geografia in Rio de Janeiro. For several years Professor Waibel, with the assistance of several young Brazilian geographers, has carried on field studies of colonial settlement in various parts of the country. His present paper, "European Colonization in Southern Brazil," is a condensation of a report presented to the Conselho in December, 1948; it focuses on the problems of forest versus grassland colonization and includes recommendations derived from observations of European colonies in both types of region.

Similarly, the newly established university at Canberra, utilizing funds from an annual grant by the Commonwealth Government, has sought the advice of experts on matters of research and curriculum and in 1948 invited Griffith Taylor, long well known for his books and articles on Australian geography, to travel, observe, and lecture throughout the continent. His particular concern was twofold: to advise on problems of the future spread of population and settlement in Australia and to stimulate the teaching of geography in Australian universities. "Hobart to Darwin: An Australian Traverse," which describes developments and landscapes along the trans-continental route through the center of Australia, is an outcome of the inquiry into settlement. And it is gratifying to note that since Professor Taylor's visit new lectureships in geography have been instituted in the universities of Adelaide, Queensland, and Tasmania.

Two other articles offer examples of independent investigations that are direct outgrowths of government-sponsored research in different, though related, fields—R. O. Whyte's "Phytogeographical Regions of Palestine" and F. Kenneth Hare's "Climate and Zonal Divisions of the Boreal Forest Formation in Eastern Canada." Both also involved collaboration with colleagues abroad. In 1945 and 1946, Dr. Whyte was charged by the Secretary of State for the Colonies with an investigation of the fodder resources of Cyprus and Palestine. In the course of his researches on the natural vegetation, he consulted with the botanists of the Hebrew University. In his words: "I visited and had a number of discussions with them, both in relation to their own problems and especially to the desire of some of them to carry out a phytogeographical survey of Cyprus, in order to see to what extent the two territories were comparable. I also recommended in my Reports a joint Cyprus-Palestine-Australian-American exploration of the Eastern Mediterranean countries for original genotypes of herbage plants, but this has not yet been possible."

*Along
Bypaths*

Professor Hare undertook studies on the climate of eastern Canada at the instigation of a Canadian government agency and while thus engaged became interested in the relationship between climate and forest types. Inevitably, he got in touch with Dr. Ilmari Hustich, a pioneer of forest studies in Labrador, and the two exchanged ideas both in person, at the Arctic Institute of North America, and through correspondence. It should be noted further that the work initiated by Professor Hare is now being carried forward by his colleague at McGill University, Mr. Harry Lash, and further results are anticipated.

What might be called "multiple-cooperative" enterprises—those involving the collaboration of several agencies or individuals from several fields—have three representatives. Dr. May's map of the "World Distribution of Poliomyelitis" is an excellent example; scientists and organizations all over the world have contributed their knowledge and resources to provide the basic data. Epidemiologists, geographers, and cartographers have met in conference to discuss which medical data should go on the map, which geographical factors were relevant, and how both could best be shown. The map contains a vast amount of information and points the way toward similar maps to be undertaken in the Society's continuing program of studies in medical geography.

*Multiple
Cooperation*

In the case of Mrs. Sanderson's researches on "Measuring Potential Evapotranspiration at Norman Wells," funds were provided through the

Arctic Institute of North America, observations were made by personnel of the government meteorological station, and assistance was rendered by local officials of Imperial Oil, Ltd. The project as a whole and its results as described by Mrs. Sanderson are of value in testing for northern latitudes Thornthwaite's formula for computing water need from mean air temperature.

"With the active collaboration" of four librarians (connected with the leading collections of geographical materials in Washington, New York, London, and Paris), Professor Harris and Dr. Fellmann have recently published a union list of geographical serials. A statistical analysis of the data contained in the union list is presented in "Geographical Serials," with the hope that it will prove both illuminating and useful.

The Fulbright program, which gives Americans opportunity for research and teaching in foreign countries, has been rewarding in many ways, particularly in the good will and understanding it has engendered and in the number and variety of field studies it has made possible.

**Other
Aspects**

Mr. Munger's paper on "Water Problems of Kitui District, Kenya," describing the measures being taken by the Akamba to conserve and make effective use of their limited water supplies, is the fruit of a year's residence at Makerere College in Uganda under a Fulbright grant. Here again there is a footnote; it is pleasing to record that Mr. Munger has recently received an appointment to continue his work, in West Africa, under the auspices of the Institute of Current World Affairs.

Dr. Fowler's discussion of "Some Problems of Water Distribution between East and West Punjab" casts light on a rather different facet of the cooperative theme. One cannot read his analysis of the canal disputes that have arisen since partition without being struck by the vital necessity for cooperation between India and Pakistan in order that a fair adjustment may be made in water use. Dr. Fowler's interest in canal irrigation in India is of long standing; service with the British Army in India during 1945-1946 provided the opportunity for a visit to part of the canal region, and stimulated further interest in recent developments.

Freedom to roam across the "boundaries" of geography and to make mutual exchange with fellow scientists is the thesis of Gordon Manley's stirring inaugural address at the Bedford College for Women. A perfect exemplar was the British geographer, Hugh Robert Mill. He was in himself a hive of associative effort, a gatherer of honey from near and far. W.B.F.

EUROPEAN COLONIZATION IN SOUTHERN BRAZIL

LEO WAIBEL

IN CONTRAST to the United States, colonization in Brazil generally has not been spontaneous; it has been organized, planned, subventioned, and directed, either by the government—federal, provincial, or state—or by private colonization agencies or large estate owners. One might then expect to find abundant details about the colonizing process, but though much has been written in a popular way, scientific studies are lacking. To remedy this deficiency I propose the compilation of “An Atlas of Colonization in Brazil.” Much valuable material is already available in the departments of “Terra y Colonização” of the several states; it awaits collection, classification, and interpretation. But personal experience and observation also are needed. For nearly three years a group of young Brazilian geographers has been studying colonization with me in both field and office.¹ We think it is time to summarize in a preliminary way our observations, ideas, and conclusions on that type of colonization of most significance, the European colonization of southern Brazil. This article is a condensation of a report presented before the Conselho Nacional de Geografia in Rio de Janeiro in December, 1948.² It essays to bring out contrasts between colonization in two markedly different regions—forest and grassland.

FOREST AND GRASSLAND

With the exception of the hilly uplands of southern Rio Grande do Sul, southern Brazil consists of three topographic regions: the *planaltos*, or highlands of the interior; the *serras*, or escarpments, which constitute the steep eastern and southern slopes of the *planaltos*; and the *litoral*, the narrow lowland strip along the coast.

Evergreen broadleaf forests once covered the *litoral*, the *serras*, and, in the *planaltos*, all the steep valley slopes with a *tierra templada* climate. The forest soil, a red clay with a dark-brown surface layer of humus, is fertile,

¹ I am especially indebted to Orlando Valverde, who accompanied me on all field excursions and contributed much to the success of my work.

² Leo Waibel: *Princípios da Colonização Européia no Sul do Brasil*, *Rev. Brasileira de Geografia*, Vol. 11, 1949, pp. 159-222. This report, which includes a map, 1 : 3,700,000, and 30 photographs, contains sections on the history of colonization in Rio Grande do Sul, Santa Catarina, and Paraná. For an earlier description of the same area see Mark Jefferson: Pictures from Southern Brazil, *Geogr. Rev.*, Vol. 16, 1926, pp. 521-547.

► PROFESSOR WAIBEL has for the past four years been serving as consultant to the Conselho Nacional de Geografia in Rio de Janeiro. In September he returned to the United States to take up his duties as professor of geography at the University of Minnesota.

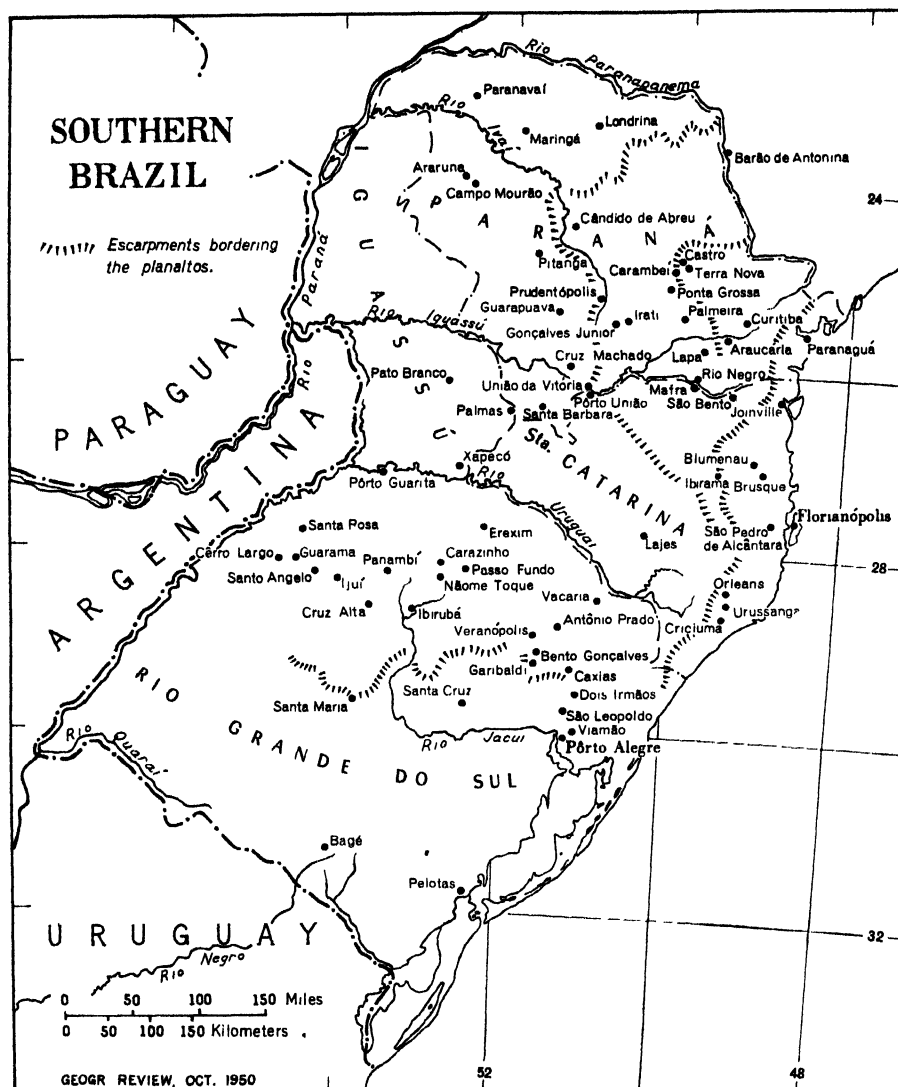


FIG. 1.—Map of Southern Brazil, 1 : 9,000,000, redrawn from the map referred to in footnote 2.

though for the most part it occupies steep and often stony slopes. On the planaltos with a *terra fria* climate evergreen broadleaf trees are mixed with tall araucarias that in places form almost pure stands. The highland forest has similar red soils, the *terra roxa* of northern Paraná and some limited areas of southern Paraná and Santa Catarina excepted, but the topsoil is considered inferior to that of the forested slopes, though cultivation is easier.³

³ Luso-Brazilians (Brazilians of Portuguese origin) classify land covered by broadleaf forest as *terra de cultura*, or "cultivable land;" land covered by araucaria forest is called *terra caíva*, from an Indian word meaning "bad forest land."

Natural grasslands cover perhaps a third or a quarter of the planaltos. Because they are treeless, they are called *campos limpos*, or clean campos. However, they are quite different from the tropical campos limpos. Besides the tall stiff grasses that characterize the tropical campos, there are many low, soft grasses forming a continuous sward not unlike that of the prairies of the humid temperate zone. Gallery forests border the river courses, and in some areas small patches of forest and woodland occur in shallow depressions as well as on slopes.

The distribution of forest, prairie, and mixed forest-prairie is highly irregular, and we are far from understanding all the factors involved. But one fact is clear: prairies generally occur on level land, often on water divides where an old topography has been preserved, whereas forests occupy the steeper slopes of valleys, uplands, and serras.

In contrast with conditions in the temperate zone, forest soils in this subtropical region are generally more fertile than campo soils. Despite many exceptions, this is indisputable. It is well known to the settlers; since the first German immigrants arrived in the 1820's almost all—99.9 per cent—of the European colonists have established themselves on forest land.

NUMBER OF PEOPLE OF EUROPEAN DESCENT

Before considering the characteristics of the forest colonization it will be well to have an idea of the numbers and origins of the people involved. The Brazilian census is not very helpful, for it classifies only the foreign-born according to origin. A better picture can be obtained from statistics of foreign-language groups and estimates of population experts. From the best available sources the figures for 1934 are:

	GERMANS	ITALIANS	SLAVS	TOTAL
Rio Grande do Sul	510,000	405,000	120,000*	1,035,000
Santa Catarina	235,000	100,000	28,000	363,000
Paraná	100,000	53,000	92,000†	245,000
Total	845,000	558,000	240,000	1,643,000

*Figure seems too high.

†Figure seems too low: it does not include the Ukrainians, who may be estimated at about 50,000.

The area and population of the three states according to the 1940 census are:

	AREA (Sq. km.)	POPULATION	
		TOTAL	PER SQ. KM.
Rio Grande do Sul	282,480	3,320,689	11.76
Santa Catarina	94,367	1,178,340	12.49
Paraná	201,288	1,236,276	6.14
Total	578,135	5,735,305	9.29

Using the estimate of the European population of 1934 and the total population of 1940 we arrive at a figure of 28.6 per cent for those of European descent in 1940. In Rio Grande do Sul the percentage is 31, in Santa Catarina 30, in Paraná 20. Of the total number of people of European descent, 51 per cent are German, 34 per cent Italian, and 15 per cent Slav.

AGRICULTURAL SYSTEMS

Both at home and abroad it has been customary to praise the agricultural methods of the European settlers in southern Brazil. But on studying their systems in the field I was shocked to discover that the majority of the settlers use the most primitive of all systems of cultivation. The settlers call it the *roça* or *capoeira* system;⁴ in geographical literature it is usually known as "shifting cultivation;" in the language of the land economist, "land rotation."

It is, of course, the system which the Portuguese *fazendeiros* took over from the Indians and have used on their great estates ever since. Its application here and in all other countries of tropical Latin America has meant the economic and spatial separation of crop cultivation and stock raising. The consequences have been far-reaching. If extensive land systems do not work satisfactorily on large estates, they are still more illogical and dangerous for small holdings. "Extensive" means that of the three factors of production—land, capital, and labor—the land is the most important; it should then be abundant. This is not so on the small farms of the European settlers in southern Brazil, yet from the beginning to the present day the extensive system of land rotation has been employed. The settlers, moreover, have adopted the cultivated plants of the Indians—corn, black beans, manioc, sweet potatoes, and even the Indian tool, the dibble or planting stick.

The sociologist Emílio Willems⁵ has realized the true character of this land system and explained its deleterious effect on cultural and social life. European small farmers cannot for generations apply such a system without losing the essence of their original culture. Especially in the old settled mountain areas and in remote places, German, Italian, Polish, and Ukrainian colonists have become true *caboclos*,⁶ poor, uneducated people, living in the most primitive fashion.

In the colonized forested areas of Brazil three main agricultural systems

⁴ *Roça* is a small patch of forest land cleared for agricultural use by burning. When cultivation ceases, second-growth vegetation, or *capoeira*, springs up.

⁵ Emílio Willems: *A aculturação dos Alemães no Brasil, Brasileira*, Ser. 5a, Vol. 250, São Paulo, etc., 1946.

⁶ *Caboclo*, at first meaning a crossbreed of white-Indian stock, is now generally used figuratively to designate any rural proletarian.

may be distinguished. The criteria are the agricultural methods used, the crop-stock combination, and the way in which the products are prepared for market. Theoretically the three systems represent successive steps in the historical development of the agricultural landscape. In practice few areas reach the third stage; many come to a dead stop in the first.

THE PRIMITIVE LAND-ROTATION SYSTEM

A pioneer family begins the cultural cycle by buying land in an uninhabited forested area. They burn and clear the forest in the Indian way; raise corn, black beans, and manioc, using the dibble and the hoe; and build a shelter, first of palm leaves, later of wood, usually without glass windows. To make use of their surplus crops they raise pigs and sell either lard or the animal on the hoof for the few articles that they need and do not produce themselves. They are connected with the outside world only by trail or primitive road. Their main contact is with a near-by storekeeper, who waxes fat while the hard-working settler ekes out a miserable existence. The colonist's children are sent to school for one or two years only, and a religious calendar is likely to be the only reading matter in the house. Regular Sunday attendance at the church, distant though it may be, is the only spiritual enjoyment. Under such circumstances social and cultural stagnation, if not decline, soon sets in. Willems describes the plight of Guabiraba, south of Blumenau, a district occupied by Germans for one hundred years. We found a similar situation in the mountainous parts of the German colony of São Leopoldo, where settlement also began about a century ago. I was shocked by the primitiveness of everything: small fields on steep slopes, some with a gradient of 60°; houses old and in decay; the speech a terribly debased German and very little Portuguese. The unfavorable impression created was in marked contrast with that made by the energetic and prosperous people of the German colony of Dois Irmãos, farther down on level, fertile lands, and of the Italian colony of Caxias up on the planalto.

IMPROVED LAND-ROTATION SYSTEM

When most forest land has been cleared, population density has increased, and wagon roads have been built, agricultural techniques and economic conditions improve. Small centers are started at crossroads for processing of food products, mostly by families of the old tradesmen. The farmers not only grow more of the Indian subsistence crops but also some European cash crops, and to the swine they add a few head of cattle. This is the type of agriculture that I call the "improved" land-rotation system. Of the intro-

duced crops wheat and rye are cultivated in winter, upland rice in summer, and potatoes the year round. These crops mean larger fields and more work. The land is tilled with horse-drawn plow and harrow if it is not too steep; but the primitive methods of the old land-rotation system still are used in cultivation.

Here I want to point a lesson, one of the most important lessons I learned in Brazil. Geographers and sociologists, following the theories of Eduard Hahn, commonly associate the use of the plow with manuring and crop rotation. This gives an entirely wrong idea of the agricultural practices of tropical America and its economic and social institutions. Plowed fields, alternating with capoeiras, are to be seen in many places in southern Brazil, and the capoeira is the best proof of land rotation. The European colonist in this, the second, stage of agricultural development cannot manure his fields even if he would like to do so, for he does not have enough cattle to produce manure in usable quantity. The two main branches of agriculture still are separate, and soils are soon exhausted.

Increased production raises the economic and cultural standard of the colonist. Houses are of better types. In contrast to the uniform shack of the pioneer they vary with the national origins except in standardized wooden houses of the younger settlements of the planaltos, rich in araucaria timber. Furniture is homemade, but the houses have more rooms and a certain degree of comfort. Children are sent to school for four or five years instead of one or two, and once in a while a newspaper or book may reach the house.

This stage of improved land rotation is most widespread. We see it especially on the planaltos, along the railway lines and highways. In areas under cultivation for only 15 to 25 or even 30 years everything goes well; yields are high, colonists are prosperous, and there is a large surplus for market. However, most areas that have been under cultivation for 30 to 50 years show signs of stagnation or even decay. Yields have declined to one-third or one-half of what they were a generation or two ago, and to make up for the loss in production the farmer puts larger areas under cultivation. This means that the period of rest has to be shortened, and the soils deteriorate still more quickly. Even on gently sloping land soil erosion sets in and campo grasses (*Aristida* spp.) invade the depleted ground. Other signs of soil exhaustion are the greater dependence on manioc, the least exacting crop so far as soil conditions are concerned, and the planting of eucalypts. Most old colonies of the planalto of Rio Grande do Sul are in this deplorable condition. The number of European caboclos is amazingly high, even in colonies which 25 years ago were considered models. In

fact, it can be said that a state of emergency exists. The more intelligent colonists realize that the system of land rotation is at the bottom of their plight. The problem is how to change it—how to turn from shifting to permanent cultivation, from rotation of land to rotation of crops.

CROP ROTATION COMBINED WITH STOCK RAISING

The final stage of agricultural development in southern Brazil is the application of crop rotation on plowed and manured fields. To have enough manure for fertilizing his land the farmer needs 10 to 20 head of cattle, and to feed them he must grow fodder crops. He also needs a substantial barn where the animals may be stabled during the night and a shed for the manure. Though everything centers round the cattle, this does not mean a decrease in crop cultivation; quite the contrary. New crops enter the picture: fodder plants such as alfalfa, vetch, broad bean, Alsine (*Spergula arvensis*), and even such vegetables as cabbage and turnip. Most are grown in winter and used green or rarely ensiled. The variety of crops necessitates a system of rotation which varies from farm to farm and from region to region. The basic idea is to alternate haulm crops with root crops and to grow legumes to enrich the soil with nitrogen. The cattle are of European stock, mostly half-breed Swiss, Holstein, or Dutch. They demand daily care, which is said to be the reason why the Poles generally do not like the system; but the Germans prefer it, and it is mainly for this reason that they have the reputation of being the best colonists.

The vastly increased agricultural production goes beyond the capacity of small local processing centers. Plants using coal or electricity are needed, and to build them requires capital, which can be provided only by cooperatives, capitalists, or banks. The products of such creameries, butter and cheese factories, flour mills, rice mills, and meat-packing plants are standardized and bring higher prices than those processed by the old primitive mills. Only a valuable cash crop permits the investment of labor and capital necessary for such improvement. In the vicinity of such towns as Curitiba, Joinville, and Blumenau in Santa Catarina, and Caxias, São Leopoldo, and a few smaller places in Rio Grande do Sul, the dependence is on dairy products; in more remote areas it is on such valuable crops as high-priced alfalfa (in the Caí valley in Rio Grande do Sul) or tobacco (in the colony of Santa Cruz).

In all these areas we find a prosperous rural population and a new type of cultural landscape. Prosperity is reflected in the house type. These modern farmers apparently do not care for the old national-style house built by their

fathers. The houses are more suburban in appearance, of brick or stone, often painted white, and with a porch on one or two sides, supported by arches. These colonists can afford to give their children a good education, and they themselves keep in touch with the outer world through newspapers, magazines, and books. They enjoy the radio and phonograph and have a standard of living comparable with that of an average farmer in the United States.

Now comes the question, how many of the European colonists of southern Brazil have reached this advanced stage of agricultural development? From personal experience in most of the colonized areas and by discussion with intelligent and experienced colonists, I have come to the conclusion that the answer is only about 5 per cent. Fifty per cent are in the second stage, 45 per cent either in the first stage or in the decadent phase of the second stage. So far as economic prosperity is concerned, I venture to say that 25 per cent are well off, 50 per cent are moderately prosperous, and the rest are in a poor and miserable condition.

Even if these figures are exaggerated, they show that something is wrong with the European colonization of southern Brazil. In my opinion three circumstances are primarily responsible. In the first place, most of the immigrants were poor, and few were trained and experienced farmers. In the second place, the government's main idea was to people uninhabited areas, and little attention was paid to the economic well-being of the colonist. In the third place, the holdings allotted were too small.

SIZE OF HOLDINGS

The proper size of holdings is vital to any colonization scheme and should be examined from every angle before colonization is started. To understand the problem we might have in mind the concept defined by the German expression *minimale Ackernahrung*—the minimum of land necessary for a farmer to maintain himself and his family on a decent economic and cultural level. It involves two main factors: the physical condition of the land and the agricultural system practiced. What is or should be the minimum land requirement for a colonist farming by land rotation?

It is generally agreed that in the forest lands of southern Brazil a family of 5 to 7 people needs about 5 hectares of land in cultivation. If we assume that the first 5 hectares cleared are used to grow crops for one year only and then lie idle three years, the colonist would need 5 plus 15 hectares or a total of 20. If he lets his capoeira grow for 6 years, he would need 5 plus 30 or a total of 35 hectares, and so on. The ideal would be to postpone recultivation of the capoeira until the original fertility of the soil had been restored. In

the opinion of most colonists with whom I talked, this would require 10 to 12 years on good land and 15 to 20 years on poor land. The minimum land requirement is, therefore, between 55 (5 times 10 plus 5) and 65 hectares on good land and between 80 and 105 hectares on poor land. These figures, of course, have only an approximate value and vary considerably in accordance with topographic and climatic conditions. But they show that 25 to 30 hectares, which is the average size of the holding of a forest colonist in southern Brazil, is too small for the land-rotation system.

Deterioration of land and people is still further accelerated by the common subdivision of the original holdings among heirs. Many colonists today own only a half or a quarter of a lot. Willems describes the situation in Guabiraba:⁷

The division of the property has come to the point that the *sítios* [small farms] no longer can sustain the large families, making it necessary for the children to seek work in the local factories. The fragmentation of holdings accompanied by erosion and economic, physical and moral impoverishment of the population is slowly but irresistibly proletarianizing hundreds of rural families. And this is taking place in a region with immense reserves of virgin land.

Under these conditions young people migrate from the farms to the towns or to new pioneering zones in which they try to get land and thus begin the same economic cycle over again. In consequence, colonists do not become attached to the land. Their attitude resembles the shifting habit of the native *caboclo* or the Indian. The overflow of the frontier of Rio Grande do Sul into the neighboring parts of Santa Catarina and Paraná is largely related to the land system. These people move on, not so much because of the increase in population as because of the deterioration of the land.

COLONIZATION OF THE CAMPOS

Campos, together with mixed forest-prairie lands, cover an enormous area in southern Brazil and have an excellent climate. Today they are occupied by cattle ranches and are thinly populated. If they could be proved to be adaptable to crop cultivation by small farmers, the entire economic and social structure of the *planaltos* would be changed. But to most Brazilians the advice to cultivate and colonize the campos is plain insanity. The firmly implanted idea that the campos cannot be cultivated rests on the belief that their soil is too poor. The fact that throughout the country campos are used only to graze cattle, whereas forest land is used to raise crops as well as stock, merely confirms this view.

⁷ Quoted by T. Lynn Smith: *Brazil: People and Institutions*, Baton Rouge, 1946, p. 511.

Is this exclusive use of the campos as pasture a consequence of physical or economic conditions? Does it follow a natural or an economic law? Or is it merely a stage in the development of Brazilian agriculture? In a paper on "Vegetation and Land Use in the Planalto Central of Brazil"⁸ I expressed the opinion that under certain conditions such undemanding crops as manioc, cotton, and pineapples can be grown on the wide-spread *campos cerrados*, though the *campo limpo* probably is unsuited to cultivation. But the Planalto Central is tropical; nothing could be more mistaken than to apply such conclusions to subtropical Brazil, where there is no dry season but a rainfall—50 to 60 inches—uniformly distributed through the year. The campos limpos here are quite different from those of the tropics; as we have said, they are comparable rather with the humid steppes or prairies of the temperate zones. The soil of the tropical campo limpo is dry, hard, and sterile; not so the soil of the subtropical campo limpo. It is true that the campo soils in general are poorer than forest soils, but there are many exceptions, and, furthermore, there is no hard surface crust, that common and detrimental feature of the tropical campos.

CAMPO CULTIVATION IN RIO GRANDE DO SUL

In the upper basin of the Rio Negro, along the railway line from Pelotas westward to Bagé, experimental wheat growing on a large scale has recently proved successful, and now the state government plans to expropriate the great cattle ranches and divide their lands among small farmers for wheat cultivation. That the steppes of southernmost Rio Grande do Sul bordering the pampas of Uruguay and Argentina should be cultivable is no surprise. It should also be remembered that in the eighteenth century immigrants from the Azores raised wheat on campo land in the eastern part of the state in such quantity that from 1780 to 1820 there was a considerable export of the grain to Rio de Janeiro.

In the western planalto one sees large plowed fields in the vicinity of such towns as Cruz Alta, Carazinho, and Passo Fundo. One or two crops of manioc are harvested, and then the land is planted with eucalypts to provide firewood for the cities. Smaller fields around the homes of the cattle fazendeiros are said to yield manioc for many years without the application of fertilizer. Corn, however, does not thrive well, and after a single harvest the field must lie fallow for several years.

On the planaltos of Santa Catarina we have seen no attempts to cultivate campo land.

⁸ *Geogr. Rev.*, Vol. 38, 1948, pp. 529-554.

CAMPO CULTIVATION IN PARANÁ

The first attempt at colonization on the campos of Paraná was a complete failure. In the years 1877-1879 the Brazilian government settled some 1000 German families from southern Russia, the so-called Volga Germans, on the campos of the municípios of Ponta Grossa and Lapa with the avowed intent of growing wheat on a large scale. Against all advice the colonists did not settle on forest land but on the campo, which reminded them of their native steppes. They plowed and planted as they were used to doing; but the crop was a total failure, and the dismayed colonists learned that the campo soils were quite different from, and vastly inferior to, the rich black earth of their homeland. About half of them left the country in despair, going either to Argentina or the United States or returning to Europe. Those who stayed either turned to commercial pursuits and became quite prosperous city dwellers or took up land on the campo-forest border, adopting the system of land rotation, cultivating the forest land, and using the campo for pasture.

Of the numerous Volga-German colonies in Paraná only four are left: two Protestant communities in Palmeira and two Catholic communities in Lapa. Each colonist was allotted 17 hectares of cultivable land in one continuous piece in the forest and the same amount of pasture land on the campo, where grazing is communal. The farmsteads, each with a half hectare of garden, are strung along a wide street. They form a compact village, the east-European *Strassendorf*, which is particularly characteristic of the Russian steppes. It might be expected that social and cultural standards would have been kept at a high level in these agglomerated settlements; but we find the same economic and cultural stagnation that marks the old settled forest areas.

CARAMBÉ: A SUCCESSFUL COLONY ON CAMPO LAND

The first unsuccessful attempt to colonize the campos of Paraná discouraged further efforts for many years. The next attempt was made by the British Brazil Railway Company, which built the line between São Paulo and Rio Grande do Sul. In 1911 at the highest point on the line, 1100 meters, on a typical campo limpo between the towns of Castro and Ponta Grossa, the company started a colony of Dutch and Germans and named it Carambé. Here, too, the objective was wheat cultivation. Despite large expenditures of capital and labor the settlement failed to prosper until the arrival of some well-to-do Dutch planters from the East Indies in the early 1930's. Now, of all the smaller colonies that I have seen in Brazil, Carambé is the most thriving—and it is located on plain campo limpo!

Approaching Carambeí across the campo limpo one sees a long, broad ridge wooded with dark-green eucalypts, dotted here and there with red-roofed buildings. The village extends for some 15 kilometers, along the crest of the ridge, and one is surprised to see modern brick houses, neat and clean, and substantial barns, better built and kept than the houses of many a forest colonist. Away from the vegetable gardens stretch plowed fields and cultivated pastures on which fat black and white cattle graze. The slopes of the ridge are covered either by natural campo vegetation or by extensive plantings of eucalyptus and acacia. The windmills turning in a constant breeze, the heavy horses harnessed to four-wheeled wagons, the many bicycles, and the blond, strong, healthy people—all make a most unusual sight for Brazil. One might be in Holland or in parts of the American Middle West.

The success of this small Dutch colony is the more surprising in that the soils of Carambeí are definitely poor in nutritive elements; calcium and phosphorus are completely lacking. However, they are deep, easy to till, and relatively rich in underground water. Such land can be cultivated only by the regular application of fertilizers. This the Dutch, unlike the Volga Germans, knew from the beginning. We were told that the British Railway Company had shipped a whole cargo of superphosphate from Europe to Carambeí. Later emphasis was put on animal manure.

Dairying is the main industry of Carambeí. On the average a colonist has 20 cows; the colony as a whole has about 1000. For year-round feed the farmer has natural as well as artificial pastures, cultivates fodder plants on plowed fields, and imports cottonseed and corn from northern Paraná. Corn, upland rice, wheat, potatoes, batatas (sweet potatoes), manioc, turnips, and Alsine are the main crops raised. The average size of a farm is between 50 and 200 hectares, of which only 5 to 10 are under cultivation, with 2 to 3 hectares planted in Kikuyu grass.

Of the 50 to 60 families in Carambeí about 90 per cent are of Dutch stock. They are organized as an agricultural cooperative and sell their products to near-by Ponta Grossa and to Curitiba.

TERRA NOVA

We found a somewhat similar situation in the much younger colony of Terra Nova, which also is in the municipio of Castro, not in plain campo but on the campo-forest borderland. Terra Nova was created by the German Gesellschaft für Siedlung im Auslande, founded and supported by the German government, which established settlements in various parts of the world according to certain plans and principles.

According to the original plan, two villages—one for Catholics, the other for Protestants—were to be established on the lands of a former cattle fazenda of 5800 hectares. Settlement began in 1932, but only the Catholic village, Garces, thrived. The reason seems to be that in Garces the immigrants came in equipped with some capital and a relatively high standard of education. The settlement was laid out on the pattern of the Volga-German villages. Each farmer was allotted 19.3 hectares of forest land and 9.6 hectares of campo land, the former to be cultivated, the latter grazed. However, probably under the influence of successful Carambeí, some of the settlers discovered how well corn and upland rice thrived on plowed and manured campo land. There is now a definite shift in Garces from forest to campo; on the latter are fine farmsteads that compare favorably with those of Carambeí. About 65 families now live in the settlement. One colonist who shifted from forest to campo cultivation pays the same amount in taxes that was formerly paid by the owner of the fazenda on which the colony was established, and the price of campo land, which initially was 25 per cent lower, is now as high as that of forest land—a circumstance perhaps unique in Brazil.

BOQUEIRÃO-CURITIBA

A third campo colony, some 12 kilometers southeast of the city of Curitiba, was founded in 1933 by Mennonites from Russia. Whereas former colonists about Curitiba had selected forest land, these newcomers bought a cattle ranch on the campo and immediately began cultivation by crop rotation in combination with stock raising. Another group of Russian Mennonites who arrived at the same time in the upper Itajaí valley of Santa Catarina adopted the primitive land-rotation system, not of their own free choice but because remoteness from market made intensive agriculture impossible. After 15 years of frustrated forest life many of them moved to the Rio Negro Valley of southern Rio Grande do Sul.

Up to the time of our visit, the Mennonites of Curitiba had not heard of Carambeí, and they did not understand my question about the origin of their agricultural system. To the president of the colony cultivation of campo land was a matter of course. He told me that the soil of the campo was not bad but that it needed more manure than the soil of the forest; on the other hand, fields on the campo are easier to keep free of weeds.

The colony has 132 families. Each of them has 5 to 10 hectares, the amount under cultivation depending on the amount of stable manure available. Potatoes, sweet potatoes, corn, and rye are the main crops. On the average a colonist has 10 to 20 dairy cattle, mostly Dutch and Swiss half-

breed. During the night they are stabled; in the daytime they graze on common pasture land rented from near-by fazendeiros. As at Carambeí, fodder in the form of cottonseed, corn, hay, etc. must be imported from northern Paraná and even from São Paulo. There is no butter or cheese factory; the milk is sold directly to city consumers.

The settlement's two streets extend along a broad ridge. Because of the recency of the development, most of the houses are simple, even primitive, cattle and humans living under the same roof. Other colonists, however, have good barns and modern houses such as one sees in Carambeí. Land prices have increased enormously. Some 14 years ago the price of one alqueire (2.42 hectares) was 1700 cruzeiros; today it is 20,000 cruzeiros, or \$1000—and this on the campo, though it is, of course, in the vicinity of a big city.

CONCLUSIONS AND RECOMMENDATIONS

From the evidence so far gathered I draw the conclusion that the campos of southern Brazil can be cultivated and colonized if intensive agricultural methods are applied and a market for cash products is guaranteed. This conclusion will probably stir up much argument, and in connection with it I should like to tell a short story. The German consulate in Curitiba published an agricultural magazine called *Centro Agrícola*. In it, in 1932, there appeared an article entitled "Colônia Utopia," which explained the disadvantages of forest cultivation and the advantages of the campo. Its author, Fritz Flugge, a forest colonist, two years later was nominated director of the Terra Nova colony. Most of the German colonists, however, thought differently from Mr. Flugge. The editor was flooded with letters violently attacking his ideas. The reasons advanced against colonization of the campos were, in part, the same as those used more than a century ago by farmers of the Middle West to discredit settlement of the prairies:⁹

The prairies were generally shunned by the first comers for several reasons: 1) Absence of trees was thought to mean that they were infertile. 2) Timber was imperatively needed for buildings, fences, and fuel. 3) They did not afford running water for stock or mills, while the lack of fuel left steam mills out of the question. 4) There was no protection from the bitter winds of winter, which, above all else, made that season disagreeable . . . 5) To the farmer, the prairies with their tough sod and matted roots constituted a new and altogether unknown problem. Men were for a time helpless before this problem, and the prairies were generally regarded as "uninhabitable for an age." As late as 1836 the few who thought the prairies capable of occupation were regarded as crazy visionaries.

⁹ H. H. Barrows: *Geography of the Middle Illinois Valley, Illinois State Geol. Survey Bull. No. 13*, 1910, pp. 77-78.

The problem which the Middle West faced a hundred years ago and which southern Brazil faces today is basically the same—the method of cultivating the prairie. In the United States, where the prairie soil is much better than the forest soil, the problem was how to break up the tough sod; it was solved by the invention of the steel plow. In southern Brazil, where the campo soil is definitely poorer than the forest soil, the solution is to apply enough fertilizer. In both cases the basic problem is not the natural contrast between forest and grassland but the economic contrast between different agricultural methods and techniques.

In southern Brazil the forest colonist can use the land-rotation system, which does not require either capital or special knowledge, only application and hard work. On the campo, too, the colonist must work hard. Besides labor, however, he needs capital to buy animals and mechanical implements and, most of all, know-how to practice an intensive agricultural system. Of course, the crop-rotation system combined with stock raising can also be used in the forest, if the forest soil is treated in the same way as the campo soil. It means plowing and manuring regularly, and of the two processes the latter is much the more important.

According to von Thünen's law, separate stock raising in the form of grazing is economically sound at great distances from market. A dry climate, likewise, tends to favor the economic separation of crop and stock raising. In Brazil, however, stock raising in the form of grazing on large ranches occurs not only in the remote interior and the dry northeast but also in the humid and once forested lands along the seaboard. *O sertão litoral*, or the demographic desert along the coast, is a typical Brazilian feature that we do not find in any other large country of the world.

The public as well as the experts is well aware of the precarious and dangerous food situation of the country. To remedy it ambitious schemes are being proposed and developed. To me, as an agricultural geographer, it seems that the most important thing to do is to end this fatal separation of crop cultivation and stock raising and to replace it with European-American methods of farming in all areas where climatic conditions permit. This can undoubtedly be done on the planaltos of southern Brazil, and it is to these regions that the following remarks apply, not to tropical Brazil, a limitation that I want to make very plain.

Brazilian farmers have to learn that soil conditions are not final and irrevocable, as are topography and climate, but can be improved or deteriorated by human means. Soils, no less than crops, must be tended and cultivated, and poor soils, if properly treated, can yield almost as much as good

soils. Application of fertilizer, natural or artificial, is the foundation of intensive agriculture of the European type. For Brazil to put it into effect will mean a break with a century-old tradition, a complete change in agricultural techniques, and the development of a new economic spirit. The old generation of forest colonists will never change from land rotation to crop rotation; they will continue to burn the forests until the last vestiges of virgin timber have disappeared. To educate the younger generation to a new way of farming will probably take a long time. Therefore I propose a shorter, more radical way: colonization of the campos of the planaltos of southern Brazil.

I do not mean that *all* the campos should or could be cultivated. There are large areas of campo limpo, especially on the Paleozoic planalto of Paraná, that definitely are unsuited to cultivation—though this is where the Dutch colony of Carambeí is located. I especially recommend for settlement the areas with a mixed forest-prairie vegetation. Each colonist should be allotted a small patch of woodland to provide him with timber for construction and fuel, but his farmstead and fields should be on campo land. Since the railway line from São Paulo to Rio Grande do Sul follows the watersheds with their open campo vegetation for hundreds of kilometers, the colonist should not have to worry much about transportation.

I shall not speak of the political and financial problems involved in the settlement, or rather resettlement, of the campos. The owners of the large cattle ranches will not like the idea, or at least they will ask exaggerated prices for their land. The greatest difficulty will be to procure the kind of colonist needed—the European small farmer, trained and experienced in intensive agriculture.

My general impression is that in colonization matters the Brazilians have thought too exclusively of the interest of the country and too little of the interest of the colonists. How wrong this is, is shown, in fact, by the country's history of colonization. Colonization is a kind of marriage between a country and a person or a family, and each party has interests, claims, duties, and rights which must be respected by the other if the marriage is to be successful. Colonists should be able to find in the new country legal, social, and cultural conditions satisfactory to them. Such conditions obtained in the northern part of the United States, which is the main reason why this part of the world received more immigrants than any other country—climate and soil were by no means excellent. Opportunities for the European small farmer are not confined to Brazil: there are possibilities in Argentina, Canada, Australia, and elsewhere. If Brazil wants to attract and keep immigrants, she must

accommodate herself to their psychology in the same way that the colonists must adapt themselves to the new country and its social and cultural institutions. What are the requirements? I omit the legal aspect and restrict myself to those features that can be studied and analyzed by a field geographer. I may add that my Brazilian assistants and traveling companions share my opinions and conclusions. I shall stress three points that I consider of particular validity.

In the first place, each colony should be an ethnic unit. By this I mean that it should be inhabited by a few hundred people of the same stock—German, Dutch, Polish, Italian, and so on. I am aware that this is contrary to current opinion and to existing law and that it will arouse much dissent. The laws of 1938 aimed at preventing national colonization on a large scale, as it had developed in some parts of Santa Catarina and Rio Grande do Sul. Most Brazilians were apprehensive of the German and Italian colonies' forming a "state within a state." To prevent national schism, the new laws provided that only "mixed colonies" could be established. It ill behooves me as a foreigner to criticize the laws of a country in which I have lived and worked; but I hope that I may be permitted to point out that Germans, Italians, Poles, and Ukrainians have done best both for themselves and the country of their adoption where they have settled in compact communities—it suffices to mention Blumenau, Caxias, the Polish colony of Araucária, and the Ukrainian one of Prudentópolis, the two last in Paraná. Where European colonists have settled in isolated communities or in small groups among Luso-Brazilians, they have either stagnated or become caboclos.

He who believes that assimilation will be expedited in the mixed colonies does not know the psychology of the immigrant, nor can he have lived as a foreigner in a foreign country. But he can check his ideas by visiting the colonial nucleus of Barão de Antonina, which was founded in 1930 by the State of São Paulo as a social experiment in mixed colonization.¹⁰ In 1938 the colony had 162 Luso-Brazilian families and 154 alien families belonging to 15 different nationalities. Lots had been so distributed that the creation of ethnic islands was impossible, and it was hoped that the foreigners would quickly assimilate Brazilian life and culture and that the Brazilians would learn improved methods of farming. What has actually happened is that the foreigners, Japanese included, have lowered their agricultural standards and adopted the improved land-rotation system of the Brazilians. There is little intermarriage, and one gets the impression that the social and cultural situa-

¹⁰ Pierre Monbeig: The Colonial Nucleus of Barão de Antonina, São Paulo, *Geogr. Rev.*, Vol. 30, 1940, pp. 260-271.

tion is not happy. It should, however, be noted that the colony is handicapped by its location in a remote corner of the state, 88 kilometers from the nearest railway station; and malaria and mistakes on the part of the administration have also interfered with the working of this experiment.

In advocating ethnic colonization I do not mean settlement of immigrants in large compact colonies, as was the case in Blumenau or Caxias. My idea is the formation of various small communities of uniform ethnic origin within the same area, for example, a German colony near a Dutch community with an Italian group between and Polish and Ukrainian settlements around, all interspersed with communities of Luso-Brazilian nationals. With such "interspersed ethnic colonization" there would be no danger of foreign nationalism developing. This principle is already at work in Castro. The same principle operated spontaneously among settlers in the United States, especially in the Middle West; but by the second and third generation it had been generally lost by assimilation, and today few traces of it can be seen.

Interspersed ethnic colonization is even more necessary for Brazil than it was for the United States. In the Middle West the immigrants found an entirely new social environment, in which the old institutions of Europe, the latifundia system, the army, and the church, had lost their power. The land was free to all, and the newcomers acquired civic rights and participated in the formation of the new society. The United States is a "New World"—not so much geographically as socially. That is what Europeans understand by the magic word "America."

The immigrant in Brazil finds not a new world but a world socially and culturally like the old world he left behind. For the Latins this does not matter so much, but for the Central Europeans it means in effect a migration, not to America, but to Portugal. This is the reason why these people, needed by Brazil because they are among the best farmers in the world, have such difficulties in adapting themselves to the new country.

In the second place, communities should be uniform in religion. To the colonist from Central Europe religion, next to language, is the most important element in his community life. To appreciate this point one must have seen how, on Sundays, colonists come in from all sides by wagon or on horseback for the church service and afterward stay for hours for company and conversation. In the old settled areas of Rio Grande do Sul and Santa Catarina religious quarrels between Catholics and Protestants have done harm to many a colony. In the newer colonies farther west the colonists often separated voluntarily on religious lines. Of great importance in any colony is the personality of the priest. He should be a leader in all its affairs. The pastor of the Protestant community of Carambei is a highly cultured

and experienced man; he acts as Dutch consul for the state of Paraná. The Catholic priest of Garces was described to me as a true leader. The big Ukrainian colony of Prudentópolis is believed to be so prosperous largely because it is directed by highly educated Greek Catholic priests. On the other hand, it is clear that the Volga Germans suffered from not having adequate spiritual leadership.

My third point is that only good teachers should be sent to colonies of foreigners. Before 1938 many colonies had their own private schools, organized by the churches. I do not know how good they were, but I do know that today almost everywhere colonists complain about the low standard of teachers in the state schools. It is a serious matter. Teachers in a community of foreigners have the difficult task of amalgamating the foreign cultural tradition with Brazilian culture and making enthusiastic Brazilian citizens out of the new generation. Parents throughout the world have only one desire: to see their children attain a higher economic and social level than they themselves were able to reach. If this should happen in the new colonies, parents, too, would be satisfied and would themselves be assimilated more quickly.

I have no doubt that colonization of the campos of the planaltos of southern Brazil as described above would be a success. I will go further and say that sooner or later the forest colonists and the Luso-Brazilian farmers of the region would have to adopt the intensive type of agriculture to compete with the campo colonists.

Finally I want to say that I am not the first to entertain such ideas for the planaltos of southern Brazil. One hundred years ago Auguste de Saint-Hilaire¹¹ wrote of the campos of Paraná:

After all that I have said it is obviously not incorrect to call the Campos Gerães the earthly paradise of Brazil. Of all parts of this Empire through which I have traveled there is no other where a colony of European farmers could be established with more success. They would find there a temperate climate, pure air, fruits of their own country, a soil which, without extraordinary exertion, would permit all types of cultivation to which they are accustomed. Like the inhabitants of the country they would raise cattle. They would collect the manure for fertilizing their fields and, with milk as creamy as that of the mountain regions of France, they would make butter and cheese for sale to the more northern parts of Brazil. What a benefit would have accrued to the country if instead of placing the Swiss colony at Cantagallo (Novo Friburgo) it had been established on the Campos Gerães. They would have taught the old inhabitants European agricultural practices, which certainly are applicable to this land. And so, happy in their new country, parts of which recall the places of their birth, they would paint for their compatriots so glowing a picture of Brazil as to attract a large and vigorous population.

¹¹ *Voyage dans les Provinces de Saint-Paul et de Sainte-Catherine*, Vol. 2, Paris, 1851, pp. 29-30.

HOBART TO DARWIN: AN AUSTRALIAN TRAVERSE

GRIFFITH TAYLOR

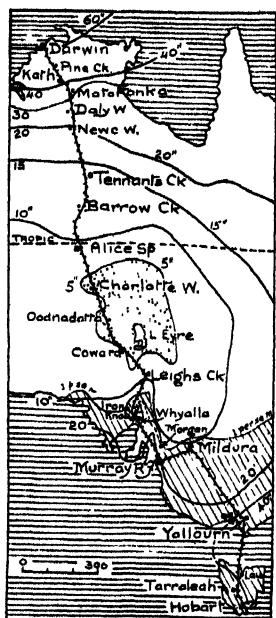


FIG. 1—Sketch map of route from Hobart to Darwin, showing isohyets, area of less than 5 inches of rainfall (stippled), area of relatively close settlement (diagonal ruling), and the pipe line from Morgan to Whyalla (broken line).

IN 1948, after 20 years' absence, I was given the opportunity to travel extensively through Australia at the invitation of the new university at Canberra and the Commonwealth authorities. I crossed the continent four times, but the most interesting journeys were those linking the far south at Hobart with the far north at Darwin. The following article records some of the outstanding features in the 2800-mile journey from the cool Tasmanian uplands through a stretch with less than five inches of rainfall in the heart of the continent (Fig. 1) to tropical Darwin, though since the journey was made in early winter I was not called on to experience the worst of that combination of heat and humidity which is the chief factor deterring tropical settlement.

HYDROELECTRIC POWER IN THE CENTRAL PLATEAU OF TASMANIA

North-central Tasmania is occupied by a triangular-shaped lava (dolerite) plateau of some 3500 feet elevation sloping gently southeastward. Its main drainage is into the Derwent River, which enters the sea at Hobart. The southern part of the plateau is dissected into five "fingers," separated by deep gorges. Here is the site of one of Australia's largest hydroelectric developments.

The first use of the power here generated was in the separation of zinc ores from Broken Hill and elsewhere about 1908. This scheme was not successful initially, and the Tasmanian Company took over the development in 1914. The water level of the Great Lake was raised by a dam at Miena at the southern end. From this point the water is led down the Shannon River to a small power station, then south by a canal to a penstock on the Ouse River, where a drop of about 1000 feet brings it to the turbines of the Wad-

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damana power station. About 120,000 horsepower is developed here, and power is conveyed to Hobart, some 60 miles to the southeast, and to Launceston, some 53 miles to the northeast. The valley between the two western "fingers" contains the upper waters of the Derwent, rising in Lake St. Clair. Here the second and third phases of the water-supply project were developed.

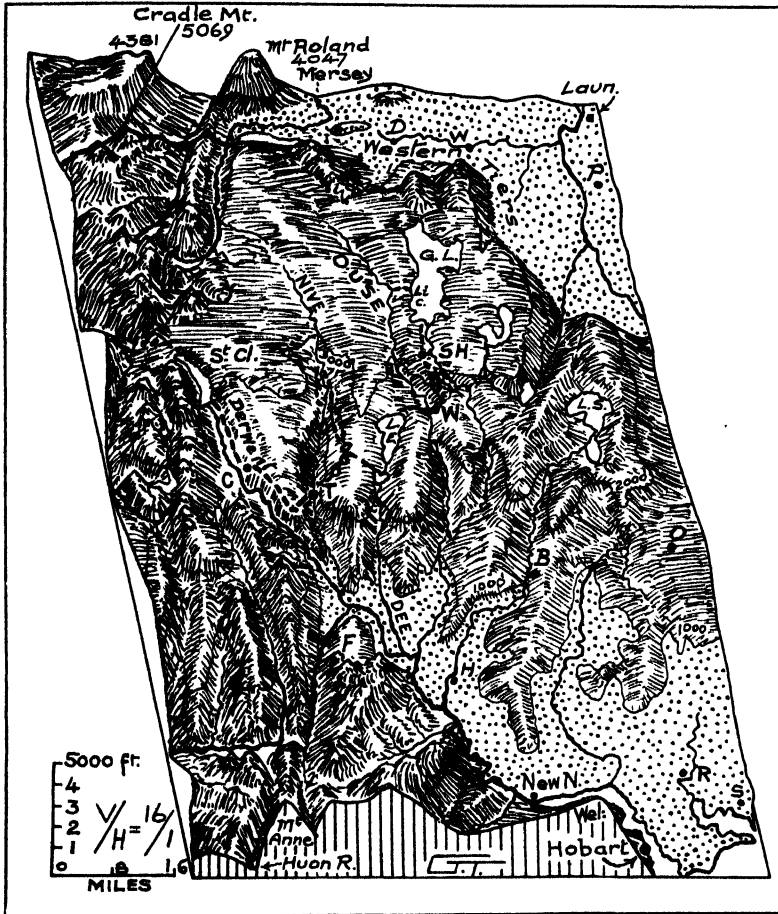


FIG. 2.—Phytographic block diagram of the Tasmanian Plateau. The power stations mentioned in the text are indicated by initials: Waddamana (W), Tarrareah (T), and Clark Dam (C).

The lake was dammed, and the water was carried in flumes some 20 miles to the deep Nive River Valley to the southeast (Fig. 2), where the Tarrareah power station was constructed. About 100,000 horsepower is now being developed here.

What may be termed the "middle finger" of the plateau still remains to be exploited. The upper Nive River and the Dee River are to be dammed,

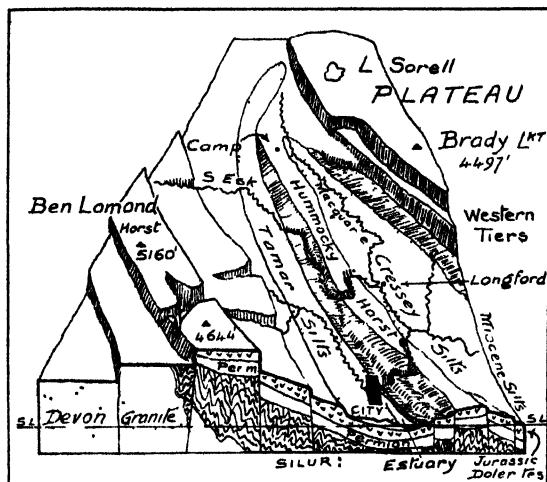


FIG. 3—Block diagram of north-central Tasmania, looking south over Launceston. The block represents an area 40 miles wide, and the horsts have been simplified (Modified from S. W. Carey.)

and a series of hollows turned into lakes and drained westward to the gorge above Tarraleah. A drop of a thousand feet will carry the water to a new power station, to be known as Tungatinah, close to Tarraleah. A fourth power scheme, the Clark Dam below Lake St. Clair, was about half finished in May, 1948. It will produce a lake as large as St. Clair, and its water is to be carried to Tarraleah to supplement the St. Clair supply.

On the rather steep shores of the estuary of the Derwent near Hobart four large factory centers have arisen, dependent largely on the power from the plateau. Electrolytic zinc is manufactured near Hobart; to the south at Electrona are large carbide works; a few miles north of the city on the west bank of the Derwent are the chocolate factories at Claremont; and across the river at Risdon and elsewhere are less important users of electric power.

Good roads now traverse most of Tasmania, including a new scenic road across the southern edge of the plateau to the mining towns of the west. The road to Tarraleah enters the rather narrow valley of the Derwent near New Norfolk. It passes through Hamilton, an old settlement of about 3000 people, noted for the cut-stone houses built by convicts early in the nineteenth century. Fine forests of eucalypts are being exploited on the sides of the valleys, but on the higher levels of the plateau the timber is smaller and scattered.

The direct route from Hobart to Launceston crosses the divide between the Derwent and Tamar basins near Oatlands, at about 1700 feet. The little town—it has fewer than a thousand people—resembles Hamilton in its old cut-stone houses. This part of the island was familiar to me from many traverses, but only recently has the topography been adequately interpreted. The major conclusions of Professor S. W. Carey are summarized in the accompanying diagram (Fig. 3), modified from his recent study.¹

At the close of Paleozoic time Permian sediments in the west and older

¹ S. W. Carey: *Topography of Northern Tasmania*, Queen Victoria Museum, Launceston, July, 1947.

rocks in the east had been reduced to a peneplain. In Jurassic time there were intrusions of wide dolerite sills, in some cases a thousand feet thick. Extensive faulting in Miocene time broke the region into a series of horsts and grabens. These still dominate the island's topography. The two lowest grabens were occupied by elongated lakes, which were separated by a rather low horst, called by Carey the "Hummocky Horst." In Pliocene time extensive basalt flows covered a good deal of the region, and some of these diverted the South Esk River from its direct path down the eastern graben, forcing it to flow into the Macquarie. Throughout late Tertiary time erosion washed away the silts laid down in these grabens. The Tamar estuary now reaches far back in the eastern graben and has captured the lower northern portion of the drainage of the western (Macquarie) graben.

The topography of today is much like that sketched in Figure 3. Here we are looking south toward the Central Plateau. The scarp is some 2000 feet high and is known locally as the "Western Tiers." However, the highest point of the island is found on the smaller plateau of Ben Lomond, where Legge Peak rises to 5160 feet. Today little remains of the "Hummocky Horst;" it rises only to 1000 feet northwest of Launceston. The same horst structure is found across Bass Strait near the summit of Kosciusko, as well as in the Flinders Range behind Adelaide and in southern Victoria. I have always believed that a horst structure of this type marks the Victorian Highlands between Mt. Bogong and the Grampians, but this view is not accepted by some Australian geologists.

THE YALLOURN-MORWELL COAL FIELD

Northward across Bass Strait and some 250 miles from Launceston we reach what is perhaps the most remarkable coal field in the world. At Yallourn, in southern Victoria, coal seams almost 1000 feet thick have been discovered along the Latrobe Valley, but there has been much faulting, and in many places the coal is too far below the surface to be worked economically.

The Latrobe River occupies a somewhat complex graben whose northern margin is an extensive fault running along the foothills of the Victorian Highlands. These are formed of older Paleozoic rocks and rise to 6000 feet. The southern margin of the graben would seem to be about ten miles away, where a parallel fault bounds the Cretaceous rocks of the low South Gippsland Hills (2366 feet). In the vicinity of Morwell, however, at least three other faults complicate the structure. Thus, along the northern part of the Latrobe Valley is the Yallourn basin. South of this is the Morwell dome (or horst), in which the coal is close to the surface. Still farther south is the Traralgon graben, where the coal is depressed far below the present surface.

Along the southern edge of the main Latrobe Valley is the Hazelwood graben, where the coal is workable, since this "step" is depressed only a small amount.

Development of the Yallourn field began after 1918. The seam here, some 200 feet thick, yields about five million tons a year. A small amount is obtained from another opencut about half a mile to the north. Of the total production of nearly six million tons, two-thirds goes to the power

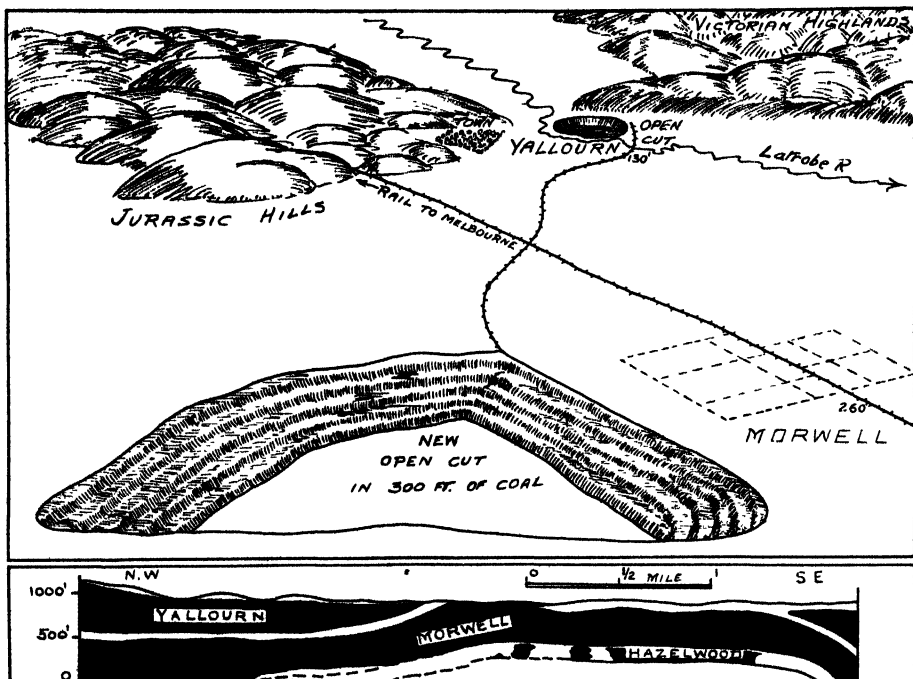


FIG. 4.—The Yallourn-Morwell coal field, showing the old and new opencuts. Structural section below.

station and one-third to the manufacture of briquettes of dried compressed coal, begun here in 1925. The raw material is essentially steam coal with a high moisture content, ranging from 33 to 66 per cent. The water content is less in the compressed deeper deposits, decreasing about 1 per cent for each 100 feet of descent.

In the vicinity of Morwell there are three thick seams totaling over 1000 feet of coal, which have been warped into a dome by converging fault movements of the bedrock (cross section, Fig. 4). In the central part—the Morwell dome—erosion has removed the upper Yallourn seam, and also the top 250 feet of the second or Morwell seam. The new developments will produce coal from the opencut shown in the foreground of the sketch. At

the time of my visit ground had only just been broken for this project, in which the coal is to be used almost wholly for making briquettes. The overburden here is about 44 feet thick, beneath which is an unbroken layer of coal 380 feet thick. It is proposed to excavate 320 feet, and it is expected that the final output of coal will be about four million tons a year. In the future a full trainload of briquettes will be run to Melbourne about every three hours, in addition to the four briquette trains that now run daily.

MILDURA—AN IRRIGATION CENTER

To reach our next scene we cross the vast lava fields of western Victoria, which fill the great valley lying between the main divide near Ballarat and the Otway Ranges in the south, covering an area of about 12,000 square miles.² Beyond lie the dry sandy and loamy plains of the Wimmera district and the Murray, here a senile stream meandering over its flood plain. No streams rise in the drier part of this corner of Victoria, the Mallee. The rainfall is only about 12 inches, and large areas near the western boundary of the state, characterized by fixed dunes of definite west-east trend, are locally termed "desert." Between Murrayville and Mildura large stretches, some of them 20 miles long, are covered with "copi" or gypsum.

Through the kindness of the Murray Valley Development League I made a traverse of almost the whole of the Murray Valley below Euston, New South Wales (Fig. 6). Euston contains only two hotels and four or five stores and has changed little since early days. On the southern bank is Robinvale, in Victoria, where sheep were grazed as early as 1847. After the First World War some 1700 acres of the region were found to be irrigable, and a few blocks were soon occupied. Today much of this area has been cleared by the government, which pays the prospective settlers for doing this work, at least in a number of cases. There has long been a lock and weir across the Murray at Euston, and recently a large pumping station was built at Robinvale to lift the water up to the new vineyards and orange groves. Plans call for the settlement of 77 former soldiers on these blocks in the near future. Around the pumping station an earth levee, some 15 feet high, has been built to keep out floodwaters.

The road along the north bank to Mildura, 60 miles away, passes through open forest of little value for timber or grazing. Hardly a house is to be seen until Mildura is approached. On the Victoria side the road passes south through Weimar and Liparoo, close to the river in places. Wheat has been

² For detailed descriptions and illustrations of the topography, see E. Sherbon Hills: *The Physiography of Victoria*, Melbourne, 1946.

grown here for 20 years, but with the low and erratic rainfall it has not been very successful. From Hattah to Redcliffs the road crosses a series of broad sand dunes, about 12 to 20 feet high and trending west-east. Wheat will grow here in good seasons, but the country is still largely unoccupied. At Redcliffs the main irrigation region begins.

Mildura is the best-known irrigation center in Australia, as well as the

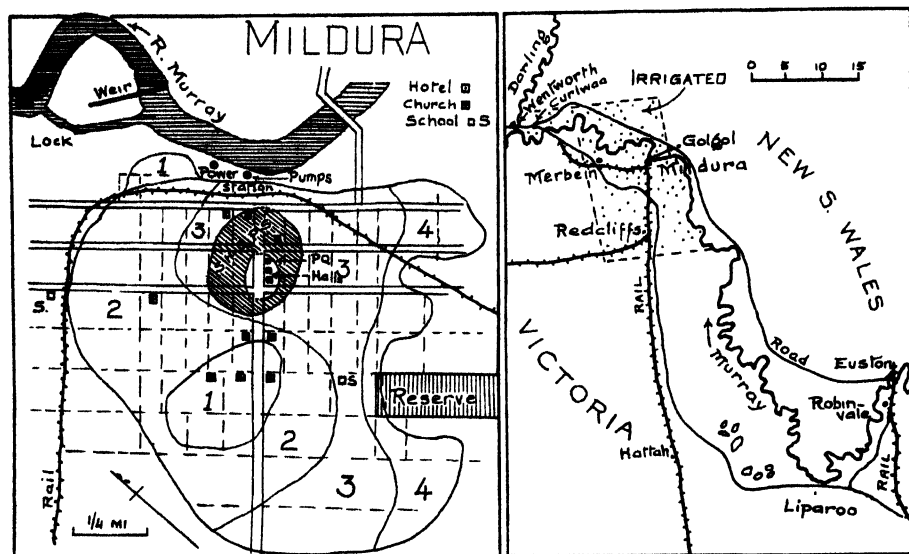


FIG. 5—Functional plan of Mildura. House types range from good (1) to poor (4). The railway station is on the riverbank, close to the pumping station. A lock has been constructed downstream, and a weir holds back the waters near the lock canal. The street along the top to the riverbank contains the chief hotel, and the main shopping street, which runs southwest from the river, contains the post office and municipal buildings. A bridge across the Murray leads to Gol Gol and Euston.

FIG. 6—Sketch map of the Murray Valley between Euston and Wentworth.

earliest. In 1887 two blocks of land, each about 25,000 acres, were made available to two Americans named Chaffey. The brothers erected four six-inch pumps, which lifted the water onto 1200 acres of suitable soil. Later large areas were irrigated near by, at Curlwaa and Merbein (Fig. 6). Population increased—in 1943 there were 8250 people living on 5760 acres—and today factories, mainly for processing fruit, have been established at the chief settlements along the river: 31 at Mildura, 7 at Merbein, and 9 in the vicinity of Redcliffs; farther to the west there are 30 near Renmark, 15 near Murray Bridge, and 5 near Victor Harbour at the mouth of the river.

From the Victoria boundary to the mouth of the Murray I saw several other irrigation areas, for example at Renmark, Berri, and Cobdogla. Swamps along the fringes of the valley, particularly south of Mannum, have been drained and reclaimed, levees have been constructed, and the flats,

which lie below river level, support rich lucerne and dairy areas. Most of these are now irrigated, as at Cowirra, Pompoota, Mypolonga, and other settlements between Mannum and Murray Bridge.

THE BARRAGES AT THE MOUTH OF THE MURRAY

The most striking developments in the last 20 years, however, are to be seen at the mouth of the Murray. The first Interstate Commission on the use of the Murray waters met in 1902, but it was not until 1930 that proposals for the erection of barrages at the mouth of the river were considered in detail. Today five separate structures, connected by roads across the low intervening islands, block the river waters within the 15 miles between Goolwa and Pelican Point (Fig. 7). The lengths of the barrages are as follows: Goolwa 2075 feet; Mundoo 2600 feet; Boundary Creek 800 feet; Ewe Island 7450 feet; Tauwitchere 12,000 feet. At the river mouth the long sweep of winds from the south has piled up one of the longest sandbanks known, nearly 100 miles. It encloses a shallow lagoon some 70 miles in length, and is known as The Coorong. At times of flood the river waters may cover a large part of the low islands shown in the sketch.

The main purpose of the barrages is to maintain the freshness of the river as far upstream as Wellington, 30 miles northeast of the mouth. They serve also to keep the waters at a sufficiently high level to permit irrigation, by gravity, of the areas already mentioned to the south of Mannum. Construction of the dams began in June, 1935, and was completed in February, 1940, at a total cost of £750,000. Most of the money was expended in damming the Goolwa Channel (1 in Figure 7), where seven-tenths of the Murray water reaches the final mouth. Some 4700 wooden piles, up to 40 feet long, were driven into the bottom; interlocked steel sheet piling of about the same depth was also driven down along the whole length. On top of this was laid a concrete platform three feet thick, which supports 122 concrete piers, with vertical grooves to hold stop logs (Fig. 8). At high tide the sea may rise above the level of the impounded lakes, so that there is pressure from both sides. In general the fresh-water level is about six feet above the salt-water level. The mouth is too shallow to be navigable and a canal has been suggested to link Port Elliot to Goolwa. A lock for small boats is provided in the Tauwitchere Barrage.

IRON KNOB AND THE NEW PORT OF WHYALLA

Our traverse now turns to the northwest and crosses the Mt. Lofty horst (Fig. 7), the southern end of the Flinders Range. Great changes in the

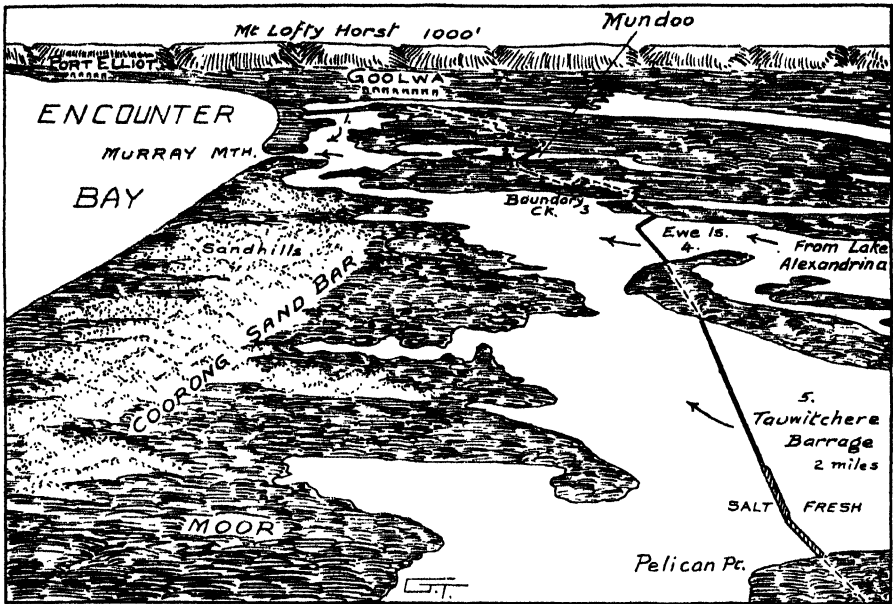


FIG. 7—The mouth of the Murray, showing the five barrages. From Goolwa to Pelican Point is 15 miles. View northwest. (Sketched from an aerial photograph.)

economy of the central part of South Australia have resulted from the working of the large iron deposits at Iron Knob. For example, water was formerly carried to the nearby port of Whyalla in ships or produced at a small distilling plant. It is now carried by pipe line all the way from Morgan on the Murray (Fig. 1), a distance of some 223 miles. The pipe line can deliver 1200 million gallons annually. In June, 1945, some 920 million gallons had been pumped through the pipes in the preceding 12 months. Of this amount about 250 million gallons was used in Whyalla, 160 million about halfway along at Port Pirie, 350 million in the Beetaloo district, 85 million at Port Augusta, and about 50 million by the railways in the vicinity.³

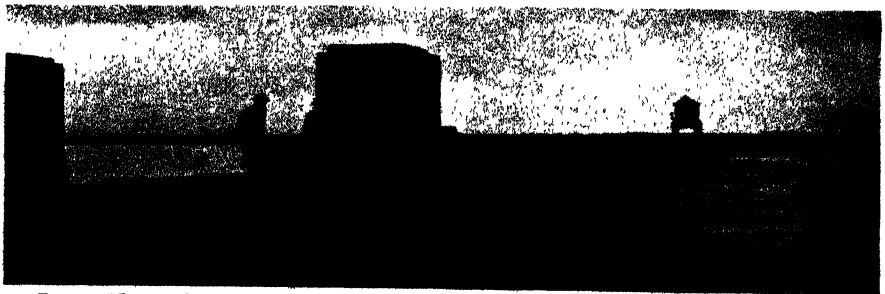


FIG. 8—The Goolwa Barrage, looking north; salt water at right. Note the traveling crane.

³ J. Macdonald Holmes: *The Murray Valley*, Sydney, 1948; reference on p. 215.

Whyalla itself had its beginnings at the turn of the century when a tram-line was built from the Iron Knob mine to the shore 34 miles to the east. In 1937 a blast furnace was built at the port, so that local ore could be smelted with coal brought some 1400 miles from Newcastle, in the holds of otherwise empty steamers. Another new industry, shipbuilding, was also undertaken in the late thirties, and in 1941 the first hull was launched.

The chief mine in the Iron Knob area is the Iron Monarch (Fig. 9). The

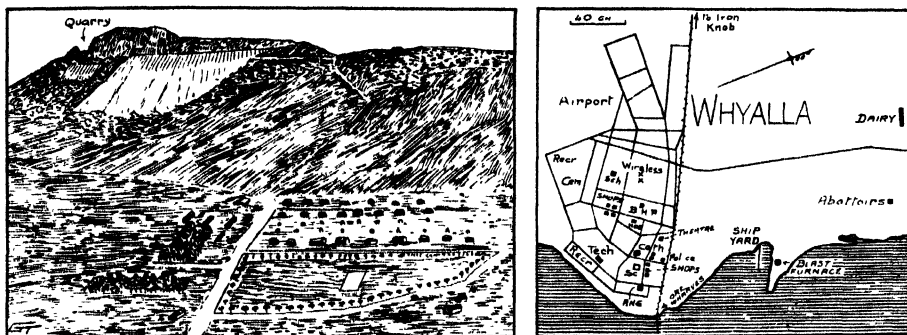


FIG. 9—Sketch of the Iron Monarch Mine, rising 600 feet above the plain. Early town site in foreground. View west.

FIG. 10—The port of Whyalla. The blast furnace and shipyards lie on the coast north of the town; the main shopping center is near the shore, but a second center has developed to the southwest beyond the Broken Hill Proprietary offices (B.H.P.). The larger Anglican and Catholic churches and the Court House are in the older part of town. In all, there are eight churches and four schools, including a Technical High School.

ore is worked in opencuts near the top of a hill of ancient schist, some 600 feet high. The deposit occurs in a flattish syncline that pitches steeply to the north. There are said to be 130 million tons of good hematite above the level of the plain. The central part of the ridge (at the right of the sketch) is formed of chert, and a smaller deposit of hematite has been worked at the north end (Iron Knob). The ore, containing 60 per cent of iron, is quarried by electric shovels, crushed to four-inch size, and loaded into tramcars that carry it to Whyalla.

Whyalla in 1948 had a population of about 8000. The town is laid out in an irregular grid extending westward from Spencer Gulf along the road to Iron Knob (Fig. 10). The 100-foot blast furnace is a landmark. It cost nearly three years' labor and a million pounds sterling to build. To produce a ton of pig iron, 3200 pounds of ore, 2200 pounds of coke (from Newcastle), and 600 pounds of limestone are fed into the furnace. Some 6500 pounds of air is also used in the smelting operation. The shipyard, originally a mangrove swamp, now contains five slipways. The yard embraces all

departments from plating and welding to outfitting. Three corvettes and nearly a dozen steamers (up to 9000 tons) have already been built.⁴

The surrounding country is sparsely occupied by sheep ranchers; the first of them arrived about 1857. The stock feeds on saltbush, which grows between the scattered mallee (dwarf eucalypts) and mulga (acacia) trees. It is estimated that the district will carry one sheep to every 20 acres.

Today, some three miles to the north of Whyalla, there is a remarkable oasis of 100 acres of lucerne irrigated by spray lines with water piped from the Murray. More than 200 dairy cows are pastured here. All modern improvements are installed for cooling and bottling the milk—and the cows enter the sheds by wind tunnels in which the flies are literally blown off them!

RECENT DEVELOPMENTS AT LEIGH'S CREEK COAL FIELD

About 100 miles to the south of Lake Eyre and some 375 miles from Adelaide are three coal-bearing basins (Triassic). The workings are mainly confined to the largest central basin. In the southern, Copley, basin the coal is interlaminated with silts, and the seams are thinner. The coal is sub-bituminous and contains 32 per cent moisture, 22 per cent volatile matter, 30 per cent fixed carbon, and 17 per cent ash. The Leigh's Creek deposit is the sole important source of coal in South Australia, but it is far in the interior and in a desert region. It has been known since 1888 but was assumed to be of little value. In 1918–1919 further surveys were made, and it was recommended that the coal in pulverized form be used in railway locomotives, but little was done until the high cost of imported coal in World War II stimulated further exploration. The discovery of coal at shallow depths in October, 1941, revolutionized the future of Leigh's Creek. The bore struck a seam 40 feet thick only 66 feet below the surface, so the deposit can be worked by opencut (Figs. 11 and 12). The coal dips on all sides toward the center of the main basin, which is roughly circular in shape and four miles across.

It is estimated that the two seams of the northern basin contain 20 million tons of coal. The larger central basin has not been so thoroughly explored, but is believed to contain as much as 360 million tons. Of the total it is estimated that 30 million tons can be reached by opencut. Quite possibly similar seams may be discovered to the north, between Leigh's Creek and Marree, on or near the railway line.

In February, 1948, an electricity trust took over the operation of the coal

⁴ I have to thank Mr. C. Ryan and the "Whyalla Booklet" for many of these facts.

field, and in June, 1948, the northern basin was opened up for production. An output of 8000 tons of coal a week is expected. Large coal-crushing and screening plants have been erected, and plans include a steam-power station and a coal-drying plant. The townsfolk have formed a cooperative society, and there is already a community hall. Tree planting around the site has been progressing favorably.⁵

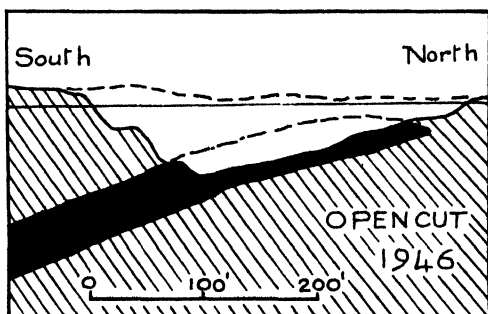
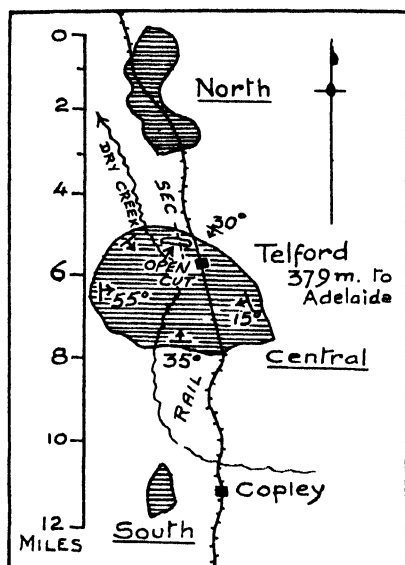


FIG. 11 (left)—Plan of the Leigh's Creek coal fields, showing the three basins.

FIG. 12 (above)—Section across the northern rim of the central coal field at Leigh's Creek, showing the 30° dip of the seam.

COWARD SPRINGS AND THE ARTESIAN BASIN

The horst that forms the Flinders Range extends north almost to Lake Eyre. Its uplift, probably relatively recent, disrupted the river systems that formerly flowed to the south. As a result a horseshoe-shaped chain of shallow lakes developed, forming a series from Lake Frome through Callabonna, Gregory, and (perhaps) Eyre, to Lake Torrens. This region was first explored by McDouall Stuart in 1859 in a journey greatly expedited by a remarkable series of mound springs. The springs flow in the driest region of Australia (Fig. 1). Some years ago I made a survey on behalf of the Commonwealth of the water-supply sources to the southwest of Lake Eyre, and the diagrams appearing in Figures 13 and 14 are based on that traverse.

The Great Australian Artesian Basin covers about 620,000 square miles, and is by far the largest in the world. Rains falling on the eastern outcrops of Jurassic sandstone, far away in east Queensland, furnish the water, which

⁵ L. K. Ward and L. W. Parkin: Leigh's Creek Coalfield, *Geol. Survey of So. Australia Bull.* 24, 1946.

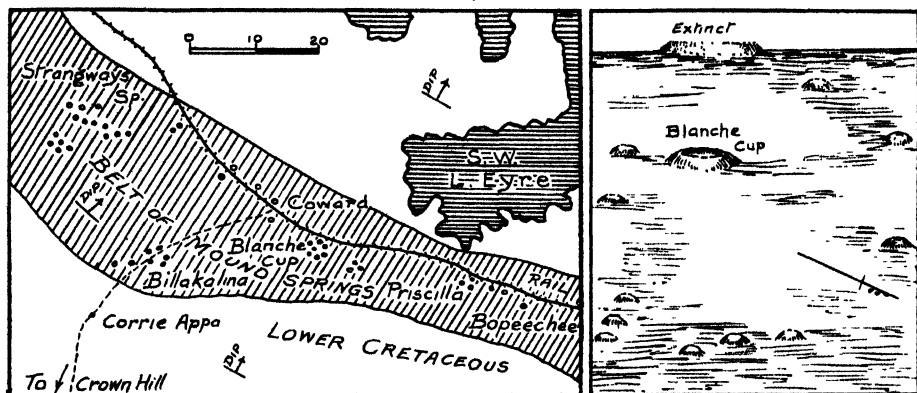


FIG. 13—The belt of mound springs that forms the outlet of the Great Artesian Basin near Lake Eyre.

FIG. 14—Sketch of a group of mound springs, including Blanche Cup.

slowly moves westward through permeable sandstones and finally, in part, overflows at the surface along the western margin of the basin. Here the land close to Lake Eyre is below sea level, but the belt of mound springs shown on the map is a little above this level. About 50 miles to the west of Lake Eyre pre-Cambrian rocks form low ranges that bound the Artesian Basin.

On an approach from the southwest the first salt springs appear at Corrie Appa near Mudlawantamaran Creek. The first mounds are at Billakalina (Fig. 13) and are 15 to 30 feet high. With a rainfall of about five inches and gypseous soil, there is little vegetation other than scattered patches of saltbush. A few cattle are supported on the denser vegetation near the swamps on Miller's Creek and other creeks. In the cup of one of the mounds I found a small quantity of water, and a small bore alongside produced a fairly constant flow. This had apparently been a favorite spot for the aborigines; heaps of flakes from chipping tools and a stone quern for grinding nardoo spores testified to their presence.

At Coward Springs four springs join in one composite mound. A strong stream flowed from one of them, but it had little effect upon the desert character of the vegetation. Coward Springs, on the railway, is the metropolis of the district and supplies the cattle stations in the vicinity, yet it contains only four houses, two of which were empty. A bore near by furnishes about one million gallons of water a day, but aside from keeping a few date palms alive it serves little purpose. Four miles south of the station is the Bubbling Spring, which supplies a permanent pool some two acres in extent. The mound is roughly 200 yards across and perhaps 15 feet high, and consists of a mass of lime sinter deposited by the cooling waters. The

whole plain hereabouts is dotted with mounds. The most striking is Blanche Cup (Fig. 14), 25 feet high and almost perfectly circular. It lies one-third of a mile south of Bubbling Spring. On the way I passed two other dead mounds, each about 25 feet high, and saw in the distance to the west a much larger mound, now extinct, indicating that in the past the outflow from the Great Artesian Basin was more extensive than at present.

ODNADATTA AND CHARLOTTE WATERS

In May I flew over the desert region between Coward Springs and Alice Springs. From the air the dendritic pattern of dry gullies in the red loamy plains is well marked by the black dots that represent scattered acacias and small eucalypts. Some broader river courses contain small pools at this season. There are a few long dunes, running almost north-south, in the vicinity of the low Denison Range. Some 60 miles south of Oodnadatta small mesas with white cliffs appear. W. A. Cannon's brief description of the landscape at Oodnadatta is worth quoting:⁶

In every direction the wide-spreading plains and flat-topped hills appear quite barren. The gibbers [desert-armor pebbles] glisten like polished mirrors in the sun, but otherwise a monotonous reddish-brown color prevails. There are thus apparently no plants to enliven the scene. . . More careful examination, however, reveals the presence of plants. Across the lower plain, for example, there extend narrow ribbons of vegetation. These converging make gray-green bands and mark the drainage channels.

Annuals are more abundant than perennials, and *Eremophila* is the most common shrub. Saltbush and acacia are, however, occasionally found in favorable sites.

To the north of Oodnadatta the Alberga River shows a wide sandy bed in a landscape of ring-shaped dunes. About 60 miles northward these give place to the north-south dunes common near Charlotte Waters. In places the dunes are somewhat crescent-shaped, with the convexity to the northeast. Occasional mesas appear near the Northern Territory border.

North of Charlotte Waters we flew over the monotonous dry valley of the Finke River for many miles. However, near Crown Point the topography changes, and much higher irregular mesas appear. Elongated dunes are still numerous, trending approximately north-northwest to south-southeast and anastomosing in places. As Ooraminna is approached—some 60 miles south of Alice Springs—rocky outcrops are more evident, and one can see the definite west-east strike of the topography in these outlying portions of the

⁶ W. A. Cannon: Plant Habits and Habitats in the Arid Portions of South Australia, *Carnegie Instn. Publ. No. 308*, 1921; reference on pp. 58-59.

Macdonnell Ranges. The ranges become dominant to the north. At the same time the vegetation improves greatly, and smooth-barked white gums replace the smaller scattered acacias of the more arid region to the south.

ALICE SPRINGS AND THE MACDONNELL RANGES

In the vast peneplain that characterizes most of arid tropical Australia, the remarkable Macdonnell Ranges have always aroused interest. Wall-like outcrops of ancient quartzite rising five or six hundred feet above the general surface are cut through by deep narrow gorges, often containing small permanent pools with a saxatile vegetation accompanied by *Livistona* palms. Simpson's Gap to the west, Heavitree Gap (Fig. 15, inset), and Emily Gap to the east are examples. We know now that the curious drainage of the Todd, Finke, and other rivers that cut through the "walls" is inherited from a period when younger Cretaceous sediments covered the whole country. Later erosion uncovered the almost vertical beds of far older formations, which include bands of resistant quartzite.

Permanent springs occur just north of the Charles River (Fig. 15), and the original Alice Springs telegraph station was built here in 1872. When the railway was extended thence from Oodnadatta in 1929, the station was placed some miles south of the springs, and the new settlement was called "Stuart." But today the old name has been transferred to the neat and flourishing little railway town almost in the center of Australia. The Todd River is normally a flat stretch of deep sand, about 200 yards wide; no water was visible at the time of my visit in May, although the rainy season was not long over. The town's water supply is obtained from shallow wells in the gravel south of Billygoat Hill (Fig. 15) and is stored in half a dozen tanks on that rocky knob.

Through Heavitree Gap, road and railway run along the west bank of the river under the 500-foot cliffs (Fig. 16). The dry bed here is 100 yards wide and is shaded by large river gums (*Eucalyptus rostrata*). The town lies a mile and a half to the north of the gap, and along the road one passes abattoirs, iron sheds that house the aborigines, a successful poultry farm, a tiny Lutheran church, and a large orange orchard before reaching the town.

Alice Springs has been built in a regular gridiron pattern between two low rocky hills (Fig. 15). Wide sandy streets are sheltered in places by large eucalypts; tall hedges of pepper tree, oleander, castor-oil plant, or small conifers separate the house plots (Fig. 17). These must be watered from wells, for there is no rain during the nine cooler months.

The Residency plot contained, in May, 1948, a small green lawn, orange

trees, and vines. Tomatoes, peas, cabbages, and sunflowers were growing satisfactorily with frequent watering from the wells, and zinnias, petunias, hibiscus, and other flowers brightened the garden. A number of small windmills raise water from the river gravels for private houses in the south end of the town. To the northeast a concrete causeway leads across the sandy bed of the Todd River to a new residential suburb. Away from the river the original vegetation consists of tussock grasses, small shrubs, and stunted eucalypts and acacias, some 30 feet or more apart.

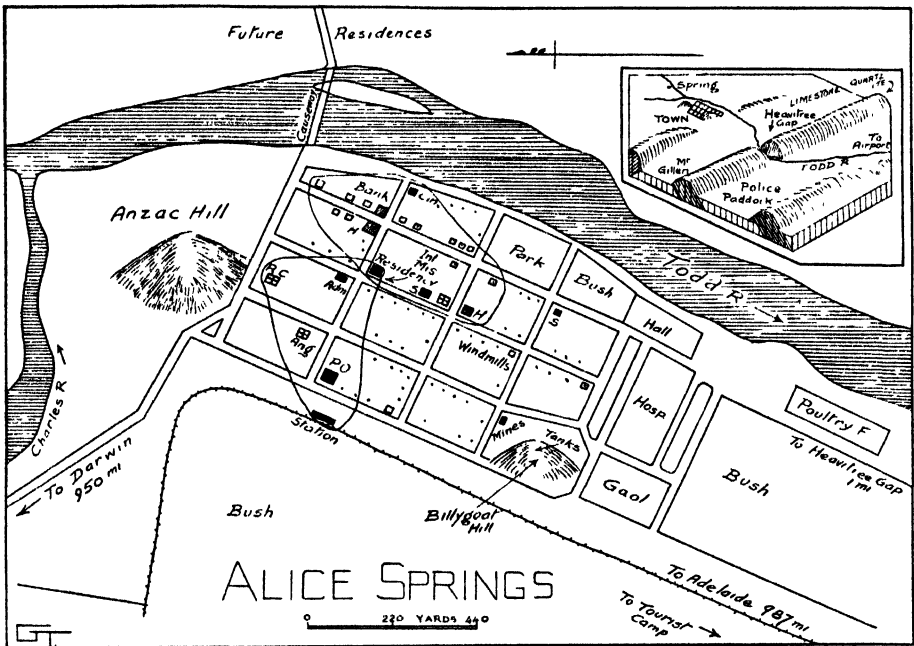


FIG. 15 - Functional plan of Alice Springs. The main road runs near the river and contains six shops on each side, a bank, and a hotel. The next street to the west serves another hotel, the school, a church, the Residency, and the Survey offices. The two principal churches are in the northwestern end of town, as are the post office and railway station. Zones occupied by shops and administrative offices respectively are outlined. Inset is a sketch of the "walls" mentioned in the text.

THE STUART HIGHWAY: ALICE SPRINGS TO BARROW CREEK

The most remarkable episode in the early history of the Northern Territory was the construction of the overland telegraph from Adelaide to Darwin, a distance of 1975 miles. By October, 1872, the line was laid, and telegraph stations were built at intervals, connected by a "bush road." For 70 years the road changed little. Until recently only one public vehicle, the mail truck, traversed it, and this only once a month. As far back as 1889 a railway had been built from Darwin to Pine Creek, and the line reached

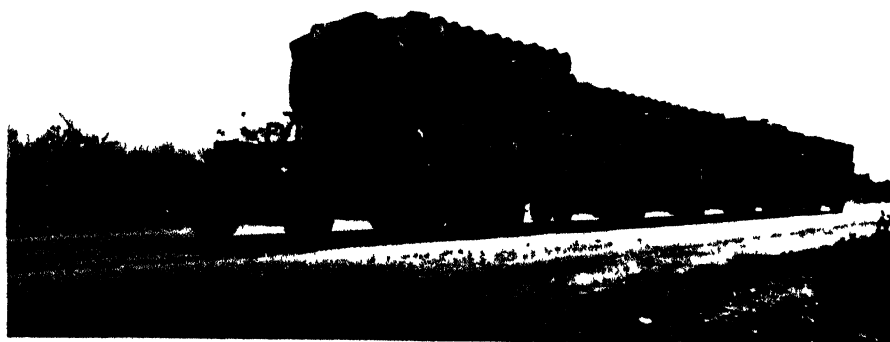


FIG. 16—Heavitree Gap in the quartzite “walls” of the Macdonnell Ranges, about one mile south of Alice Springs. The railway is at the left, paralleling the highway, dry bed of the Todd River at right.

FIG. 17—Alice Springs, looking northeast from Billygoat Hill. The Todd River lies in the background, behind the town.

FIG. 18—The Stuart Highway, some 40 miles south of Barrow Creek. Central Mount Stewart is visible in left background. Truck and trailers are loaded with empty gasoline drums for sale in Adelaide.

Birdum about 1928. In the south the railway north to Oodnadatta was built by 1891; in August, 1929, the extension to Alice Springs was opened to the public. Under the Japanese threat, in 1942, the federal government built a tarred road of excellent quality (Fig. 18) from Alice Springs to Darwin. Some 700 miles of the semidesert country of central Australia is served only by this Stuart Highway (or, as it is locally known, the Bitumen Road) or by air.

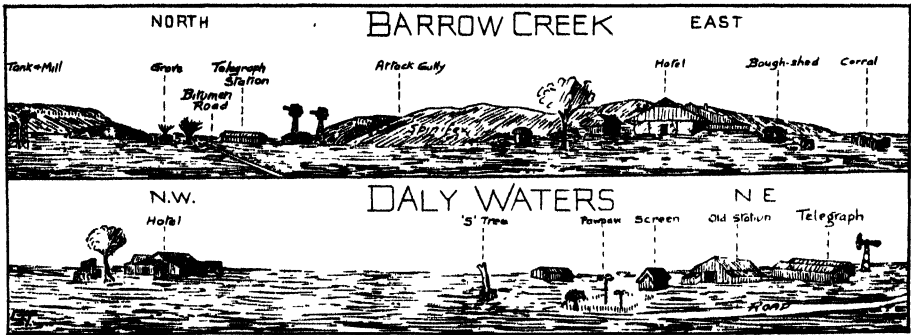
Primitive but by no means uncomfortable hotels are strung along the route at intervals of about 200 miles. The first after leaving Alice Springs is at Aileron. The wide plains are covered with mulga, and there are a few eucalypts up to 30 feet high. At the time of my visit there was no sign of water in the gullies, but during the war bores had been put down which tapped ground water at intervals, and shallow wells occur about ten miles apart. Flats covered with thickets of lancelike acacias or spinifex grass characterize the route as far as the Hann Range. The range rises only a few hundred feet and is capped by a harder layer of rock. A few cattle were seen, and we met only two cars, these just as we reached Aileron. The small hotel near the homestead and one or two other houses make up the settlement.

North of Aileron termite nests about two feet high are widespread over the plains. At Teatree Well meals may be obtained at a small teahouse, embowered in green *Parkinsonia* trees. In the vicinity I saw an amphibian jeep with a propeller, somewhat out of place in the arid center of Australia! Its searchlight was used to dazzle kangaroos, which are shot after sundown. The hides are cured with salt scraped from nearby salt pans.

The road passes close to Central Mount Stuart, one of a group of low rounded hills with cirquelike hollows—not, however, ice-carved—on the slopes. Here we met a huge trailer caravan laden with empty steel petrol drums. These relics of the war find a ready sale in Adelaide. At times the trailers carry as many as 80 bullocks from drought-stricken areas. The sterile soils and poor rainfall made this section, north to Tennant Creek, the worst part of our semidesert journey. Small rock-capped mesas are common; the well-known telegraph station at Barrow Creek stands at the base of one. At Barrow Creek the stone buildings, built to withstand attacks by the aborigines, still survive—the graves of early operators killed by the aborigines are a grim memento of distant days—and little has been added to the settlement (Fig. 19). About a quarter of a mile to the east is a hotel with the usual corrugated iron roof. Several windmills, raising water from the shallow wells, and wind motors, producing electric light, complete the picture.

TENNANT CREEK AND NEWCASTLE WATERS

The same undulating country with poor tussock grass and much bare loam is seen north of Barrow Creek. Low bushes alternate with patches of close-set acacia, some ten feet high. The Crawford and Osborne Ranges, though marked on the map, are too insignificant to be identified in the landscape. The topography, however, becomes more hilly as the Davenport Range, near Wauchope, is approached. I was told that this marked the northern limit of the rabbit pest. Here some outcrops of granite have weath-



FIGS. 19 and 20—Field sketches of two famous telegraph stations established in 1872 and little changed throughout three-quarters of a century.

ered into remarkable tors, known locally as "The Devil's Marbles." White gums become more abundant near Tennant Creek, and small mesas and a few conical hills appear. A few miles south of the little town several small gold mines have recently shown promise.

Tennant Creek is the sole settlement of note in the central part of the huge Northern Territory (523,620 square miles). The Bitumen Road constitutes its main street, along which there are two hotels, a bank, a cinema, a newspaper office, a score of stores, and some thirty private houses. The principal buildings are raised on short piles, indicative of hot climate and the need for ventilation. A few mines are to be seen in the hills to the southwest, and a radar station crowns a nearby hill (Fig. 21).

Northward from the little town the landscape is marked by a prevalence of thickets of small trees about 15 feet high. Tussocks of grass are abundant, but there is little underbrush. Near Attack Creek, where Stuart was driven back in 1861, there are many small hills and juvenile valleys. Here one enters some of the poorest country on the whole route—rocky soil covered mostly with tussocks of spinifex, with occasional low mesas capped by a hard rock layer (Fig. 26). In the vicinity of 18° S. new types of trees such as corkwood,

baubinia, and grevillea were noted. Gray and white spotted gums and bloodwoods grow to a height of 30 feet, though they are not abundant so far south. We did not pass through Powell Creek and had only a glimpse of Lake Woods some distance to the west. This lake may be as much as 20 miles long but it is usually dry by August. Near by the main road to Queensland branches to the east, and the greater part of it has been surfaced with bitumen like the Stuart Highway. We crossed Newcastle Creek by a stony causeway and climbed a low hill to Newcastle Waters.

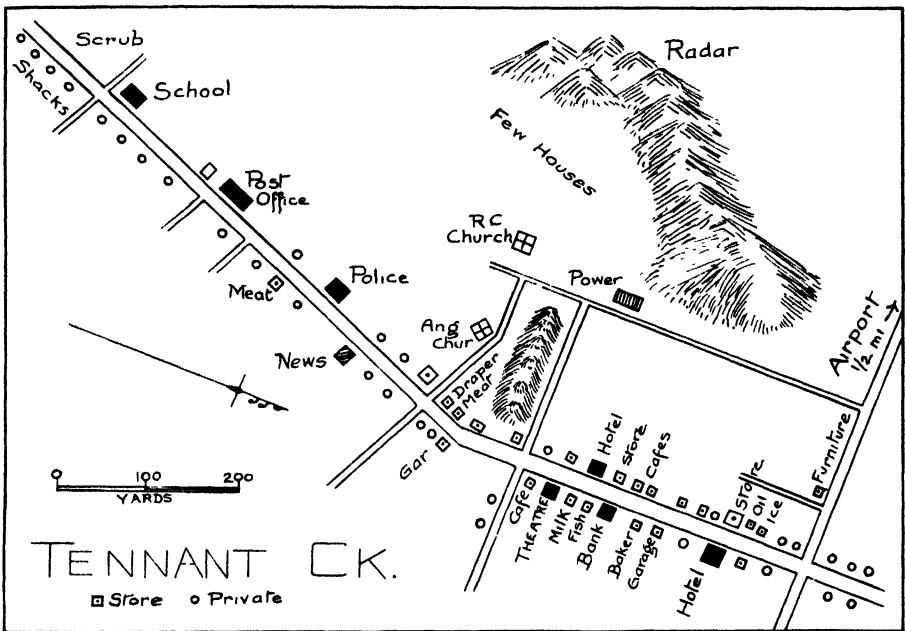


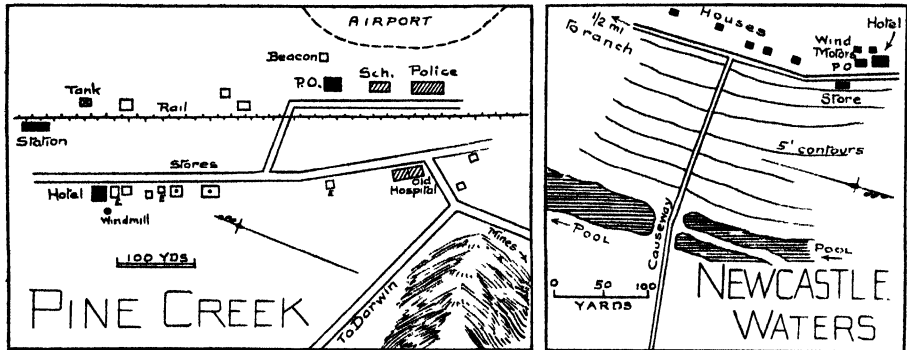
FIG. 21—Site view of Tennant Creek.

This famous telegraph station is much less imposing than Tennant Creek. The settlement consists of the usual hotel, a large store, and half a dozen private houses (Fig. 23). The creek here was a string of shallow muddy pools; the main road again crosses it at a fine water hole where there were numerous waterfowl. A considerable improvement in the country takes place north of Newcastle Waters, and Mitchell and Flinders grasses replace useless spinifex. The continental divide lies about halfway to Daly Waters, though there is no obvious topographic feature to indicate it.

DALY WATERS, MATARANKA, AND KATHERINE

Some 50 miles north of Newcastle Waters we reached Dunmara cattle station. Peanuts were growing in a small garden. Trees scattered over the

level country give a parklike appearance to the landscape. The soils, however, are poor, and the termite nests larger, a few being four feet high. Thickets of acacia are still common. As usual we met only two or three other vehicles the whole day long. At Daly Waters there are two clusters of buildings about a third of a mile apart—the telegraph station, consisting of three or four large sheds of galvanized iron, some of which are badly infested by white ants, and the usual galvanized iron hotel, under large eucalyptus trees.



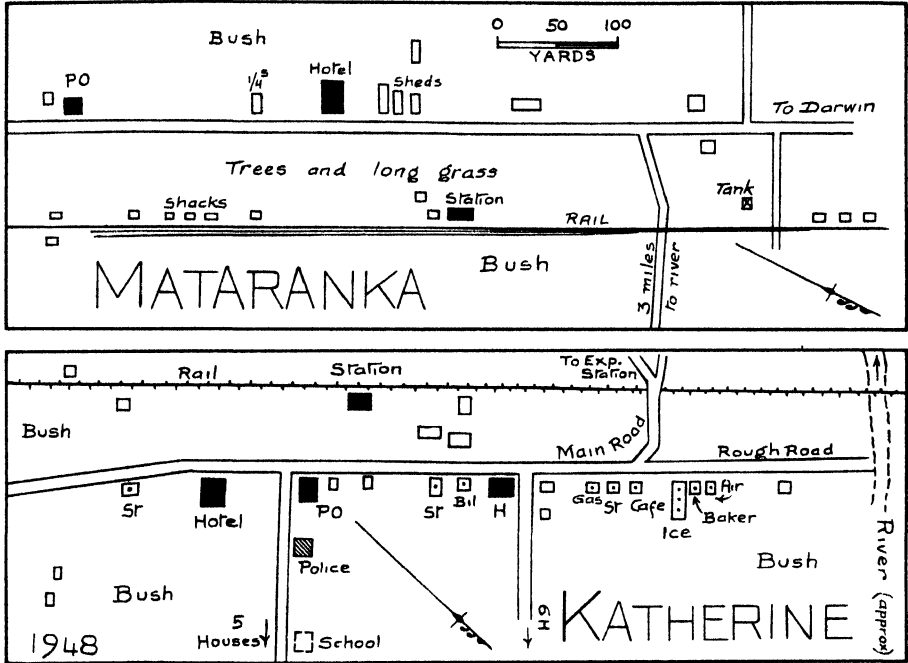
FIGS. 22 and 23—Sketch plans of Pine Creek and Newcastle Waters.

Between the two groups of buildings is a dead tree with the letter "S" carved on it, probably by Stuart in 1862 (Fig. 20). Many goats wandered below the trees, and the hotel was draped with bougainvillea and other ornamental vines. A small airfield lies to the southeast of the telegraph station.

Beyond Daly Waters much the same open woodland was traversed; here were rather scrubby coolibahs and other eucalypts, many with smooth salmon-colored bark. Near the end of the northern railway is Larramah, where the road convoys from the south terminated their journeys during the war. Hundreds of abandoned iron huts and sheds stand as relics of the war years. Birdum, near by, is the railway terminus, but unless the line is continued to Barkly Tableland there seems little reason, especially since the meat works have been abandoned, for connecting Birdum with the unattractive region near the coast at Darwin. The termite nests here were larger, some five feet, and had pinnacled crests. A dozen miles south of Mataranka we crossed the Elsey River by the first notable bridge on our journey. Not far away is the station depicted in "We of the Never-Never," and its hero, Æneas Gunn, is buried in the adjacent cemetery. Along the river we saw the first thickets of pandanus, typical coastal trees.

Mataranka (Fig. 24) consists of a rather large rambling hotel, half a dozen houses, the railway station, and some fine trees, including numerous

sterculias, poincianas, and tamarinds; the native eucalypts were much larger than those farther south. On the Roper River a few miles to the east we found a good sample of a gallery forest. Passiflora vines with edible fruit climbed through the undergrowth; in a large pool blue water lilies were growing, giving rise to a scene quite different from anything seen hitherto. But a few yards away from the river is the usual open, rather xerophytic, woodland of the Territory.



FIGS. 24 and 25—Sketch plans of Mataranka and Katherine.

From Mataranka to Katherine there are many hills and shallow valleys with the usual sparse forest cover. We did not stop at Marranboy, where there has been some tin mining in the past. Here the geological features change, and low ridges of limestone appear on each side of the road. As we approached Katherine (Fig. 25) numerous abandoned iron sheds showed the importance of the town as a military base. Indeed, both Katherine and Mataranka were bombed by the Japanese. Of the settlements along the road, Katherine ranks second to Tennant Creek in size; the railway station lies on the south side of the rather deep valley of the Katherine River. There is a low concrete bridge (Fig. 27) some distance to the west, where the Stuart Highway crosses the valley. In the wet season cars can manage to get across on the railway bridge.

The chief item of interest at Katherine is the experimental farm a few miles to the west, near the famous "Springs." Unfortunately the best land is only a narrow strip in the form of a levee. Cotton, pawpaws, and bananas were being watered from the river and were growing well. South American lucerne, a close-growing legume whose dried leaves seem to be a valuable fodder for stock in these tropical areas, broom millet, peanuts, and tobacco are also crops that show promise. A settlement of 20 Russian immigrants in the vicinity is growing peanuts successfully. However, it must be remembered that good soils are quite limited in the Territory. The heavy summer floods make it almost impossible to use the river soils of the valley floors for agriculture.

KATHERINE TO DARWIN

Northward from the Katherine River limestone outcrops at frequent intervals. Long cane grass grows in places; cycads are common in the sparse undergrowth. Callitris trees appear among the eucalypts, and at the Fergusson River I noticed many pandanus trees about the edge of a large pool. Near Pine Creek abandoned diggings on the side of a low granite hill are a reminder of an important gold field in days past. Today Pine Creek (Fig. 22) is a very small settlement; an abandoned hospital is the most imposing building.

To the north of Pine Creek the country is rocky and seems to have little pastoral value. Small palms, about four feet high, are abundant in places under the larger eucalypts; callitris and pandanus are frequent in low places. Deep valleys between flattened ridges appear on both sides of the road near Brock's Creek, another scene of bygone mining. The termite nests here are much larger, one near the Adelaide River being about 12 feet high (Fig. 29). Bamboo-fringed creeks containing water became fairly frequent. Coomallie Creek supports a narrow fringe of gallery forest, similar to that along the Roper River. At Berry Springs, a former army hospital and rest camp, were hundreds of empty iron huts and a number of bamboo sheds put up by the Chinese. A beautiful swimming pool in the Berry River, flanked by concrete paving, had served as a popular resort for convalescent soldiers in the closing years of the war, and it is hoped to make it a vacation spot for folk from Darwin, 40 miles away. The surrounding country is clothed in eucalypts up to 40 feet in height, somewhat scattered and with no marked underbrush, though rough grass covers much of the surface. A large dam across the Manton River provides Darwin (population 2676 in 1947)⁷ with a

⁷ In 1933 there were 1566 inhabitants. I have to thank the Administrator, Major Driver, and Mr. Rose, of the Veterinary Service, for information about the Territory.



FIG. 26—Castle Rock, 100 miles north of Tennant Creek. A characteristic view in the semidesert region. Tussock vegetation and clumps of spinifex in foreground; small termite nests at right.

FIG. 27—Low concrete bridge over the Katherine River a few miles below the town. Pandanus and melaleuca trees grow along the stream.

FIG. 28—Bungalows in the northern suburbs of Darwin. House on right has been bombed out. Note corrugated iron roofs, fiberboard walls, and piles with metal caps to obstruct insects.



FIG. 29—Large termite nest near the Adelaide River, some 75 miles south of Darwin. Compare with those shown in Figure 26

plentiful water supply. Indeed, it is said that a city ten times as large could be supplied without difficulty.

Although Darwin was first established in 1868 and is one of the well-known ports in the world, I do not know of any geographical survey of the city. The town is situated on Port Darwin, a typical ria (Fig. 30, inset), on the eastern headland at the mouth of the bay. Roads and railways enter the town from the north (Fig. 30) and lead to a small horseshoe-shaped inner harbor which faces south-east. Here Tertiary laterites cap beds of Cretaceous shales, and cliffs of the latter rocks, some 60 feet high, surround much of the headland. The northern suburbs, where the cemetery and Botanical Gar-

dens are situated, are on lower ground than the town and its western suburbs. Sand beaches front the open ocean west of the town, and the shallow eastern waters on the bay side are fringed with mangroves.

Darwin suffered a good deal of war damage; the official buildings near the harbor and one bank and one hotel were badly bombed, and most of the Chinese quarter was demolished. But Darwin has today a neat, well-cared-for appearance.

ECONOMIC POSSIBILITIES NEAR THE HIGHWAY

At the conclusion of our long traverse it may be well to summarize economic possibilities of the Territory in the vicinity of the Stuart Highway. Mining and agriculture have not been of much importance in the past, so that we may confine our attention chiefly to the cattle industry, which is still the mainstay of settlement. It is convenient to divide our traverse into five sections, based essentially on the amount of the summer rainfall—there is no rain in the nine cooler months of the year in almost all this large region. Since the natural vegetation is the best indicator of a country's capabilities, this aspect of the environment is stressed.⁸

The section from Alice Springs to Barrow Creek has a rainfall of 10 to 12 inches. The valuable fodder saltbush (*Atriplex*) grows sparsely and

⁸ Many of the tree data which follow are taken from the recent memoir by M. R. Jacobs: *Eucalypts of the Territory*, Canberra, 1945

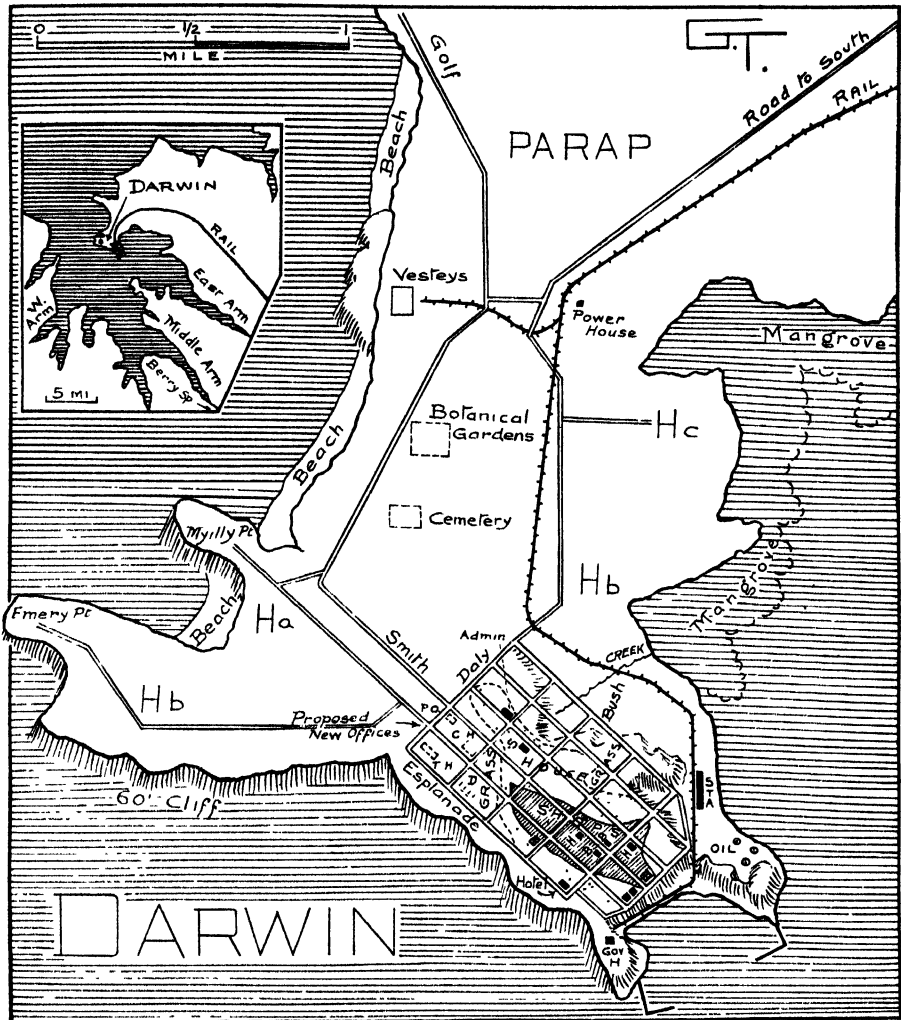


FIG. 30- Functional plan of Darwin. House types range from good (Ha) to poor (Hc). The town is laid out in a conventional grid, the main axis running southeast-northwest along the low plateau of the promontory. The Esplanade follows the top of the cliffs on the west and south sides and contains the older government buildings just behind the inner harbor. New offices are planned for the near future, to be built at the northwestern end of the Esplanade. Sites of the proposed courthouse, town hall, and post office are indicated by initials. Two small capes embrace the inner harbor, the western is crowned by Government House, the eastern shelters numerous oil tanks on low ground near the railway station. Vestey's abandoned meatworks are shown to the north of the town.

here reaches its northern limit. There are a number of cattle stations near the road, which runs between the huge western desert and the smaller Arunta Desert on the east. Among the eucalypts thicketlike mallees are common, including such species as *gamophylla*, *mortisii*, and *pachyphylla*. Larger rough-bark eucalypts, such as *intertexta* and *polycarpa*, are also to be seen.

From Barrow Creek to Tennant Creek, in the belt of 12 to 14 inches of rainfall, the best country lies east of the road, where there are wet-season creeks rising in the low Davenport Range. Here large red gums (*Eucalyptus rostrata*) grow in the creek beds, and also bloodwoods, corkwood, beefwood, melaleuca, gidgee, and thickets of acacia akin to lancewood and brigalow.

From Tennant Creek to Daly Waters the rainfall ranges from 15 to 25 inches. Poor country lies both east and west of Tennant Creek, primarily because of the sandy sterile character of the soils. There is practically no pastoral occupation, though a little to the northeast lies the excellent cattle country of the Barkly Tableland, near Lake de Burgh and Brunette Downs. Along the road in the vicinity of Lake Woods and Newcastle Waters there is a narrow pastoral belt, but with unoccupied country east and west.⁹ Smooth-bark eucalypts such as *aspera* and rough-barks such as *microtheca* and *terminalis* characterize this section.

From Daly Waters to Pine Creek (25 to 40 inches of rainfall) lies poor stock country. Indeed, the railway was extended to Birdum mainly to bring southern cattle quickly across this area to the meatworks at Darwin. The heavier tropical rain produces rank grasses not relished by cattle, and the soil here is generally rather sterile. Rough-bark eucalypts such as *ferruginea*, *pruinosa*, and *pyrophora* are abundant.

From Pine Creek to Darwin (40 to 60 inches of rainfall) there are scattered cattle stations west of the road, where zebu hybrids stand the heat, ticks, and drought better than the usual breeds. Three white men with 40 aboriginal helpers can run a station of 200 square miles in this section. Here the common eucalypts are *grandifolia*, *miniata*, and *latifolia*.

⁹ Griffith Taylor: *Australia*, 2nd edit., New York, 1943. See map on p. 205.

WATER PROBLEMS OF KITUI DISTRICT, KENYA*

EDWIN S. MUNGER

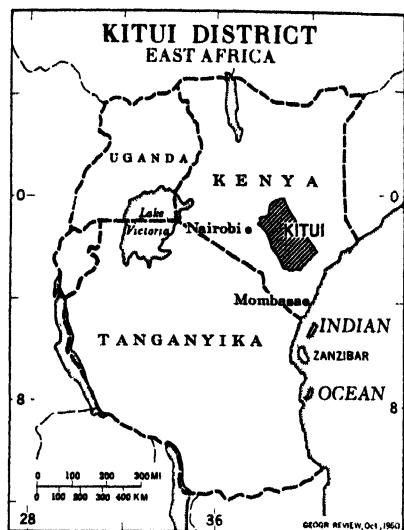


FIG. 1.—Location map.

KITUI DISTRICT in Kenya Colony has many problems, but of paramount importance, and related to most of the others, are those concerned with water. Water is the principal determinant of land use. Its yearly presence or absence means prosperity or possible starvation.

Kitui District occupies an area of 18,000 square miles, of which 6000 is Native Reserve. It lies, for the most part, at elevations of 2000 to 4000 feet between the coastal plain and the highlands to the west. Hills of gneiss and schist rise above a dry, rolling, eastward-sloping plain of red lateritic soils covered with thornbush except where

scattered native *shambas* dot the countryside. There are no permanent streams; in wet periods the district is drained by "sand rivers" (Fig. 7), the largest of which, the Tiva and the Thua, may barely reach the Tana River but usually end in the bush. A population of 214,000, including fewer than 1000 non-Africans, is concentrated in the southwest around Kitui Township, where the land is higher, hillier, and wetter.

The inhabitants, the Akamba, are of eastern Bantu stock and in the past were one of the more backward tribes of Kenya—and the indigenous tribes of that colony were among the least advanced in Africa. The Akamba are agriculturists, but they also keep large herds of cattle and goats; on the Yatta Plateau, however, and around the confluence of the Kithiolo and Tana Rivers tsetse fly restricts cattle grazing. Women do the shamba work, planting and hoeing with primitive sticks or, increasingly, with iron implements. Political organization is simple. The British District Commissioner relies on chiefs, or headmen, selected by him, from candidates nominated by the

*The writer wishes to express his appreciation for the generous hospitality of the District Commissioner, Mr. W. F. P. Kelly, and Mrs. Kelly.

► MR. MUNGER is at present in East Africa, engaged in field studies under a Fulbright research grant. He will continue his work, in West Africa, under the auspices of the Institute of Current World Affairs.

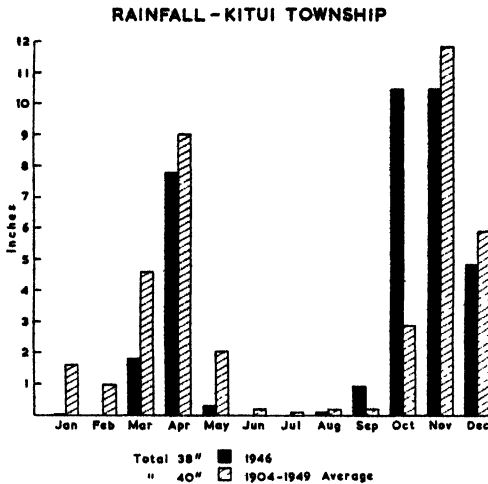


FIG. 2.—Monthly rainfall graph of Kitui. The year 1946 is more representative than the 1904-1949 average. Of the 45 years, 36 show at least one rainless month.

has shown a progressive attitude toward the solution of water problems.

AN EQUATORIAL RAINFALL REGIME

Kitui District follows the typical equatorial regime of two dry and two wet seasons (Fig. 2). Rainfall ranges from an average of 40 inches a year at Kitui Township to 18 inches in the northeast. Records of the 10 district stations cover from 1 year to 44 years (at Kitui Township); the average length is 10.7 years, altogether too short a period from which to generalize. However, the records do reveal that yearly fluctuations of 10 inches or more are not unusual. Convection is the primary cause of local rains; orographic rain in connection with the southeast and northeast monsoons gives the western part of the district its higher precipitation.

The rainfall regime shows remarkable uniformity and from year to year, averages for every station indicate that the first wet season usually reaches a maximum in April and the second in November, but there may be sharp deviations. For example, if the second rains come late, a station may record one inch in November when the average calls for eight inches; conversely, dry months on both sides of the normally wet ones may receive heavy rains.

CONSERVATION OF WATER

The rain that falls on Kitui District would be sufficient to support good crops and fine pasture if the supply were timed and used most effectively. When a quarter of the yearly total comes in a single month, and half of that

people, to exercise local authority in the 22 "locations" of Kitui District, in some of which there are also "sub-headmen." A Local Native Council, composed of 17 elected chiefs and 6 government appointees and representing the entire district, is being given more and more authority in education, public works, taxation, conservation, and general policy. The council's support is virtually essential to the success of district projects. So far it

in two storms, the ground becomes saturated, and rapid runoff produces disastrous soil erosion. Within a few hours large, silt-laden streams make the roads impassable and wreak havoc on the cultivated land. The streams may dry up in a few months, but the forces of destruction multiply from year to year, and under such conditions water is more of a burden than a blessing.

This problem is being attacked in two ways: the construction of dams and the terracing of land. The government is carrying out a plan to dam the larger intermittent rivers. Most of these are too small, and the number of dams needed is too great, to justify the expense of all-concrete construction by the Kenya Colony Dam Building Unit, but concrete cores and spillways will be used in the larger dams. The present program calls for 50 earth dams a year; 32 were completed in 1949. They differ in size but are generally some 15 feet high and 250 feet long, with a capacity of a quarter of a million gallons to 20 million.

The physical work is undertaken by the people who live in the area; the government furnishes engineering plans, wheelbarrows, and picks. When a dam is completed, the Local Native Council contributes \$140 to the community. This may be used to purchase food or equipment for shambas, or otherwise as seen fit. At present each chief is required to build two dams a year, one in each dry season. This is an enormous undertaking for the village. All the people turn out under the eye of the chief or sub-headman. Men work in gangs, swinging their pickaxes in unison to the rhythm of their singing. Other men trundle wheelbarrows, and women form a long line and pass shallow baskets full of dirt from the excavation to the top of the dam wall. The younger girls walk as far as six miles to fill calabashes with water for the workers to drink.

Water bailiffs are appointed and paid by the Local Native Council to see that engineering plans are carried out between inspection trips. They make sure that the spillway is sufficiently below the top of the dam wall, and that a wide catchment area around the dam is fenced off with brush piles so that the water will not be contaminated by cattle dung. Sometimes, however, it is necessary to allow cattle to puddle the basin at a low-water period so that their trampling hoofs will pound the dirt and dung into a watertight base. Final supervision is made by the District Commissioner, who periodically checks on building progress and maintenance.

Dams are built on two principal sites. Some small ones are constructed around the base of sloping rock outcrops, which serve to collect water. Others are built to hold back the water rushing out of a network of deep dongas or gullies. How successful a dam will be is difficult to predict. Some "reservoirs"



FIG. 3 (upper left)—Dam under construction. At right, line of women passing baskets of earth to top of dam wall; in foreground, District Commissioner talking to local chief.



FIG. 4 (upper right)—Beating the earth into place on dam wall.



FIG. 5 (lower left)—Women passing the baskets of earth. The important task of dumping is reserved for a man.



FIG. 6 (lower right)—Borehole site. This hole is not properly managed; to avoid contamination it should be fenced, the animals led to the trough for watering, and then led away.

hold water perennially; others may dry up in a few months, if the year is dry and the people draw a good deal of water. Some dams may leak for a time; others, not properly constructed, may burst in a period of heavy rain. On the whole, however, every dam is successful to some extent in reducing erosion and providing a larger and more conveniently located water supply. Since there are innumerable sites where a dam of the present size, or even smaller, could be placed, as many as 300 effective dams could be built in the district.

Terracing is the second means being encouraged for retaining water and retarding soil erosion. In 1946 roughly a thousand acres were terraced; in 1947, 1800; in 1948, 3500; and in 1949, more than 4000. Most of this work has been done in areas of heavier rainfall, where the need is greatest. The Akamba's understanding of the need for contour plowing is growing. Unfortunately for Kitui District, the rainfall is not sufficient to support the elephant grass that has been used successfully in terracing elsewhere in East Africa in hilly areas with greater precipitation.

In spite of improvements, the educational process is slow and difficult. Chiefs are encouraged to adopt progressive methods and teach by example; primary schools, and especially the secondary school in Kitui Township, are used as demonstration centers for the older men and training grounds for the young people. The secondary school already has five dams on its adjoining school farm, and 40 more are planned. Modern methods of agriculture and mixed farming are carried on by the students as part of their practical training.

Another facet of the conservation program is erosion control on the steep and almost barren hillsides. Most of the higher hill slopes are suitable for forest; in fact, many of them were forested in the past. Unlike some other tribes, the Akamba were never completely driven into the hills by the cattle-raiding half-Hamitic Masai from the plains, and they continued to use the valleys and plains for grazing and agriculture. One result of this may be the presence of fine residual forests on the ridges and higher hills. Podocarpus, cedar, black wattle, and gum trees all grow well in these areas, and with a little encouragement forest will spread down the hillsides. The Akamba, however, have the habit of burning the high grasslands every year in order, they believe, to destroy the dead grass and improve the new growth. Large areas have been set aside as Kenya Colony Forests, and the Local Native Council is experimenting with plantings on its own land. If the excellent mist forests of the higher areas could be extended and new forests and grass cover developed, erosion could be checked and water released gradually;



FIG. 7.—A sand river. Although such rivers are dry for most of the year, the Akamba seldom fail to find water by digging shallow wells in the stream bed.

moreover, the forests would supplement the increasingly smaller supply of poles for huts, and some trees, such as the black wattle and podocarpus, would provide a cash income.

None of this is simple to accomplish. The land must be acquired from the native owners; small groups of people who may at present be cultivating it must be resettled; and finally, firebreaks must be cut and fireguards hired (about six dollars a man monthly). But the red hills with their 20° slopes blackened and bare of vegetation are an unspoken argument for the need for immediate action.

INCREASING THE AMOUNT OF WATER

One attack on the problem of increasing the amount of water in Kitui has been to sink wells to tap ground water. In nine attempts seven boreholes have been successfully drilled, one by the British Army during the campaign against Italian Somaliland and the rest under the auspices of the Local Native Council. Two of the boreholes are operated by hand pumps, which make them mechanically simple, and two have Diesel engines to raise the water from a greater depth (as much as 600 feet); these latter require transported fuel supplies and increased maintenance. Proposals have been made to charge a small fee for the privilege of watering cattle—a sum that would cover upkeep (estimated at \$14,000 a year) after the government has made the initial expenditure. In areas of lowest rainfall boreholes should be a great blessing, for during droughts there may be literally no water and the cattle die or must be driven many miles to new watering places already occupied by other natives. Unfortunately, however, boreholes are entirely outside the native's traditional knowledge, and psychologically they seem to be less desirable than dams, which can be built and maintained with local labor and a minimum of outside supervision and funds.

MINIMIZING THE EFFECTS OF DROUGHT

If, despite conservation and efforts to increase the supply, there still is not enough water, the problem can be approached from another angle. Acute water shortage means withering crops and dying stock. In the old days famine was the next stage, but the possibility of that extreme is declining. What will help to counteract local crop failures is continued development of better means of transport. Transport in Kitui District means roads, built and maintained by either the Public Works Department of the government or the Local Native

Council. Roads (all earth) are generally being improved, and since the war there has been an increase in the number of African-owned lorries carrying foodstuffs and goods within the district and to the outside world.

Although government relief is now available to prevent starvation, it is far better that provision against drought and famine be made locally. In recent years District Commissioners have reported that the economy is shifting from one based on cattle to one based on money. Nowadays a suitor may substitute an approved number of goats for each head of cattle or may purchase with cash the required number of cattle to be paid his prospective father-in-law—a trend accelerated since the war by returning *askaris* with discharge pay and accumulated savings. Cattle and goats are still the accepted medium of exchange, but they are becoming symbols of convertible wealth rather than wealth itself. The amount of money in circulation in the district has increased so enormously as to inflate cattle prices to such an extent that many young men cannot raise enough for the bride price and either remain unmarried or defy tradition by eloping. As regards famine relief, however, it is desirable that many families should have cash reserves, so that they can purchase food in difficult times.

Growing of new, drought-resistant crops is another method of attacking



FIG. 8—A typical small dam, photographed from 12,000 feet. A cluster of huts surrounded by a brush fence may be seen in center foreground.

the problem. Millet cultivation is widespread, even where, despite its hardness, the crop may fail in one year out of three. On the other hand, the people are learning to grow more cassava; some chiefs require that a certain acreage be planted to cassava each year. Its rootstocks can be dug up when other crops fail, and it is safe from invasions of locusts, which in bad years may strip every bit of greenery from an entire village and its surrounding area.

THE FUTURE OF KITUI

The future of the Kitui Akamba may be a rising standard of living based on better use of land and water. Setbacks do and will occur, but it is encouraging to sit at a *baraza* and hear men ask the District Commissioner for permission to collect funds for a new school rather than wait two years until the expanding government school-building program reaches their village, or to visit a dam and see that the villagers have toiled an extra two weeks to make it broader, higher, and stronger than the plans called for. The people are fortunate to be under the guidance of an administration that has their confidence and knows how to direct their improvement. The natural resources of sun, soil, and water are available; the wisdom of their use will determine the progress of Kitui.

SOME PROBLEMS OF WATER DISTRIBUTION BETWEEN EAST AND WEST PUNJAB*

F. J. FOWLER

AMONG the many problems resulting from the partition of India is that of establishing the ownership of, and the right to use, the water in the rivers that flow into West Punjab from East Punjab and Kashmir (Fig. 1). It is a problem intimately linked with the whole Kashmir question; to Pakistan the threat of interference with vital water supplies is probably the most serious aspect of that question.

In several parts of the world the problem of water rights is by no means new. Political boundaries seldom coincide with those of catchment areas, and accordingly the exploitation of a river by one political unit often jeopardizes its utilization by another unit. The distribution of river water for irrigation canals has been determined by several principles. There is, for example, the law of riparian rights, by which the owner of land contiguous to a stream has proprietary rights. In India this law has not been upheld in practice, or there could have been no large-scale diversion of water for irrigation. Then there is the doctrine of prior appropriation, by which the first user of water acquires a priority right, whether or not his land is contiguous to the stream. Finally, there is the principle of equitable distribution, which regards a river as an indivisible unit to be developed for the benefit of the maximum number of people regardless of territorial boundaries. In India this principle was recognized in the early days of British administration, and it has been adopted under numerous international treaties the world over.

In India, though the most important rivers flow through more than one administrative unit, there has been no statutory law on water rights, but the policy of equitable distribution could be enforced by the central government, since it had executive power to impose its decisions in all interprovincial and interstate disputes. Under the India Act of 1935, which came into force in April, 1937, irrigation became a purely provincial matter, though provision was made for the appointment of commissions to investigate complaints relating to water rights and irrigation. This change did

* Paper read at the Annual Meeting of the Institute of British Geographers, Cambridge, January, 1950. The writer wishes to thank the Secretary of the Central Board of Irrigation, Government of India, for statistics relating to discharges of rivers and canals, and also to acknowledge gratefully the assistance given by Professor A. V. Williamson, head of the Department of Geography, The University of Leeds, in the preparation of the paper.

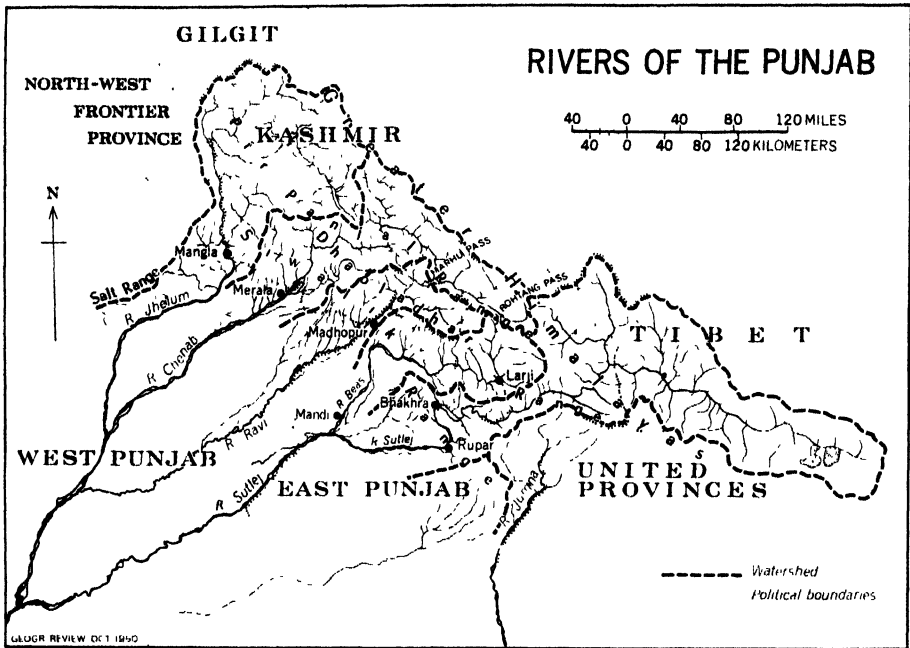


FIG. 1.—The five main Punjab rivers, showing Himalayan catchment areas.

nothing to facilitate the settlement of disputes, and the frequent deadlocks and frustrations that occurred indicate the desirability of a centralized, all-India, policy that nevertheless permits local freedom of action in constructing irrigation works.¹

GROWTH OF THE PUNJAB CANAL NETWORK

Under such a system the irrigation network of the Punjab came into being. It was developed by the provincial government after the Government of India had impartially considered the interests of a large number of people widely separated territorially, and hence the available water supply of its five rivers was apportioned in what was felt to be to the maximum advantage of all concerned. Limitations of space prevent detailed description of the historical development of the network, but the salient features may be sketched (Fig. 2).

At the time of the British annexation of the Punjab in 1849 several groups of inundation canals were already in existence, but they were inefficient, and the need and desirability of extending perennial canal irrigation were evident. Accordingly, in 1851 work began on the Upper Bari Doab Canal,

¹ "Waterways of India," Government of India Central Board of Irrigation Popular Ser. Leaflet No. 4, May, 1947, pp. 4-18.

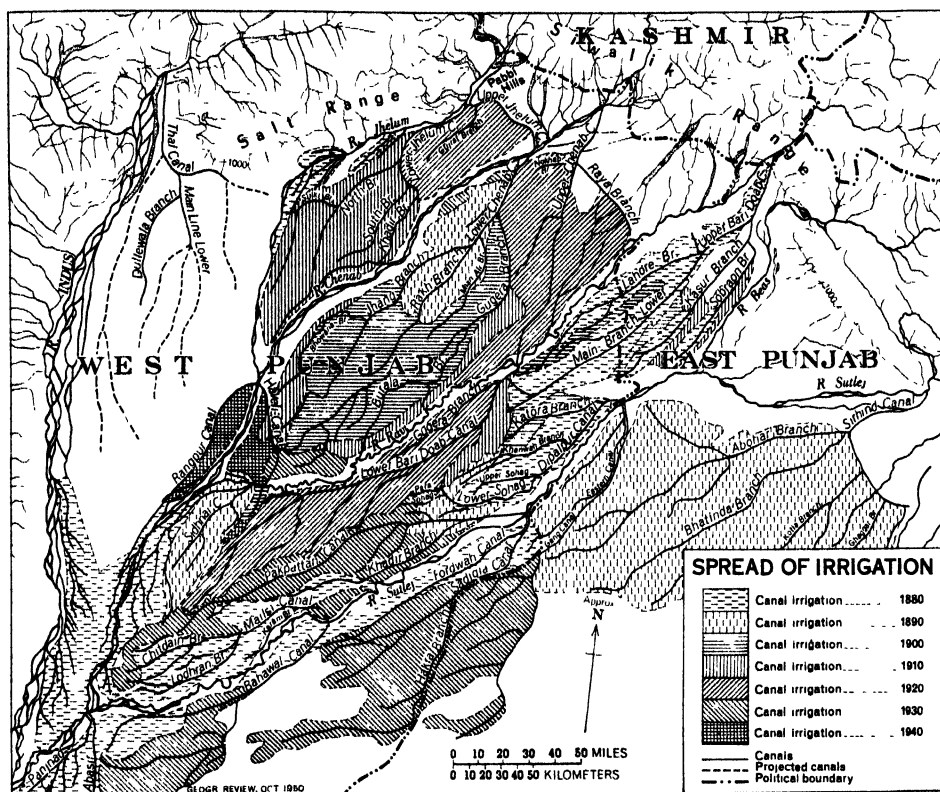


FIG. 2.—East and West Punjab canals, with historical development of irrigation

which takes off from the Ravi at Madhopur (Fig. 2). In the early eighties the Sutlej was tapped at Rupar by the Sirhind Canal, and about the same time the Lower Sohan and Para Canal and the Sidhnai Canal were brought into use. The Lower Sohan was an inundation canal branching from the Sutlej below its confluence with the Beas; the Sidhnai was weir-controlled, but as the Ravi was dry in winter, neither was a success from the cultivators' point of view. The reclamation of the Sandal Bar, a large waste area between the Chenab and Ravi Rivers, was then given preference. A small inundation canal constructed in the late eighties proved a failure, but the Lower Chenab Canal, which superseded it in 1892, eventually became not only one of the most extensive but also one of the most efficient and successful canal systems in India, if not in the world.

Irrigation in the Jech Doab followed the opening of the Lower Jhelum Canal in 1901, and attention was turned to the area south of the Ravi. It was impossible to feed a canal from the Ravi, since the Upper Bari Doab Canal already utilized all the winter discharge of that river. Alternative

sources were available, but not easily accessible, in the Jhelum and Sutlej Rivers. When the intricacies of the engineering problems involved in tapping these sources had been fully examined, it was decided to transfer the surplus water of the Jhelum by an Upper Jhelum Canal into the Chenab River to help feed the Lower Chenab Canal. The Chenab water thus set free could then be taken by an Upper Chenab Canal across the Rechna Doab, carried over the Ravi by a "level crossing," and fed into a Lower Bari Doab Canal. This "Triple Canal Project," as it became known, was completed in 1917, and the transfer of Jhelum water left the way clear for the utilization, in the 1920's, of the surplus water in the Sutlej below its confluence with the Beas. Controlled by a series of four weirs, the Sutlej was made to feed canals on both banks: on the north bank, the Dipalpur and Mailsi Canals, which superseded unsatisfactory inundation canals, and the Pakpattan Canal, which extended irrigation into waste land; on the south bank, the Eastern, Gang, Sadiqia, Fordwah, Bahawal, Abasia, and Panjnad Canals, which nourish an extensive area, much of it within Bahawalpur State.

With the completion of this Sutlej Valley Canals Project, irrigation was widely spread over the southwestern Punjab, but small areas in the extreme southwest of the Rechna Doab remained uncommanded, and irrigation facilities of the old Sidhnai Canal and inundation canals in Multan District were far from satisfactory. Accordingly, the Haveli Canal Project was prepared and executed. The four major canals on the Jhelum and Chenab Rivers utilize most of the available winter supply, but percolation is such that a reasonable amount finds its way back to the rivers and is available below their confluence, and here the Emerson Barrage was opened in 1940. From its east end the Haveli Canal crosses the tip of the Rechna Doab and meets the Ravi upstream of the Sidhnai Canal, the distributary system of which was enlarged to link up with the inundation canals in Multan; from the west end the Rangpur Canal takes off.

PROBLEMS ARISING FROM PARTITION

The boundary between India and Pakistan cuts across the hitherto unified Punjab irrigation network, giving rise to obvious difficulties. West Punjab is left with an area dependent on the tail branches of the Upper Bari Doab Canal, which takes off from the Ravi in East Punjab. Even under a unified control designed to ensure equitable distribution of water, in years of low river flow cultivators on tail distributaries always tended to accuse those on the upper reaches of taking an undue amount of the water, and after parti-

tion any temporary shortage, whatever the cause, could easily be attributed to political motives. It was therefore wise of Pakistan—indeed it became imperative—to cut the new feeder from the Ravi for this area and thus become independent of distributaries in East Punjab.

In the second place, the Ferozepore weir now lies within East Punjab. Three canals take off from this weir: the Eastern and Gang Canals, which irrigate Ferozepore District and Bikaner State in India, and the Dipalpur Canal, which irrigates Lahore and Montgomery Districts in Pakistan. Obviously, water for the Dipalpur Canal is directly controlled by East Punjab, though a small part of the west-bank training bunds that guide the floodwaters over the weir remains in West Punjab, a most unsatisfactory state of affairs.

Furthermore, in the vicinity of the Sulaimanke weir, which controls the water entering the Pakpattan Canal in Montgomery and Multan Districts and the Fordwah and Sadiqia Canals in Bahawalpur State, all in Pakistan, the boundary has not yet been finally settled. The Boundary Commission intended that the Sulaimanke headworks should remain in West Punjab and, if the delimitation of the boundaries of Montgomery District did not ensure this, that adjustments should be made awarding West Punjab enough territory to cover the headworks. The weir itself is in Montgomery, but important protective embankments, which Pakistan rightly maintains are an essential part of the headworks, lie in Ferozepore District of East Punjab. Hence Pakistan now seeks boundary modifications by an impartial tribunal; meanwhile there is a dispute that turns on the interpretation of the word "headworks" in the Radcliffe Award.

Finally, a small area on the tail distributaries of the Eastern Canal remains within Pakistan.

"CANAL WATER DISPUTE"

It is not surprising, then, that a "Canal Water Dispute" is among the differences obtaining between the two new Dominions; allegations about canal stoppages have been made and refuted by responsible ministers on both sides. The development of this dispute may be outlined here, since the major issue now is not so much the minor territorial claims relating to ownership of weirs and headworks but the fundamental claim to the ownership of water in the five rivers entering West Punjab from East Punjab and Kashmir.

In December, 1947, India agreed to supply, on payment, water to Pakistani canals from headworks in East Punjab. In April, 1948, however,

the supply to the Dipalpur Canal and the lower reaches of the Upper Bari Doab was discontinued; the reason given was that Pakistan had failed to renew the December agreement.² The issue was referred to Inter-Dominion Conferences in May and June, 1948, and an agreement resulted under which Pakistan recognized India's need to develop irrigation in East Punjab famine areas in the Sirhind Plateau and agreed to a progressive reduction of the supply of water to the canals in West Punjab. India promised to continue to supply these canals for a reasonable period of time, i.e. a period sufficient to enable Pakistan to tap alternative sources; this, India suggested, could be done in seven years. At that stage the discussions ended. From July, 1948, canal supplies continued without interruption, but there were disputes about the payment for the water as distinct from payment of a share of the maintenance costs of headworks.

The 1948 conferences made it clear that India interprets the Punjab Partition Order to mean that East Punjab and the acceding states have a prior and superior claim to the rivers flowing through their territory; that is, riparian rights are legal not only under the terms of the partition but also in terms of equity.³ India argues that it was the policy of the united Punjab to develop irrigation in the western part, where there was a large area of crown wasteland capable of yielding a quick financial return, and that this postponed development in the eastern part, where the land was privately owned and where no major project was constructed after the opening of the Sirhind Canal in 1882; that the Canal Colonies in the west were developed in part by Hindus and Sikhs, who were forced to emigrate to India after the partition; and that only a small proportion of the revenue derived from irrigation, only a small share of the water supplies of the rivers, and only a fraction of the canal-irrigated cropped area of the united Punjab remain in East Punjab. These arguments cannot be assailed, but it must be emphasized that the western part was not developed for the exclusive benefit of that part but for the whole Punjab: a principal objective of the colonization policy was to benefit the eastern part by relieving pressure of population in its more congested areas, and the financial return accruing to the Punjab government was shared indirectly by all parts of the province.

It is unnecessary to labor the point that Pakistan refuses to recognize the validity of India's case and maintains that in accordance with "international law" West Punjab has a prior claim to at least the share of the waters of the westward-flowing rivers authorized before the partition and in addition has

² *India Record*, Vol. 1, No. 38, Sept., 1949, pp. 5 ff.

³ *Ibid.*, p. 7; also Vol. 1, No. 41, Oct., 1949, p. 3.

a legal right to a share of any increase in volume of water which can be made available by storage works along the rivers. Accordingly, in June, 1949, Pakistan suggested that the matter be referred to the International Court of Justice and proposed, if India refused, to lay the dispute before the Security Council.⁴ India did not agree but in turn accused Pakistan of seeking a settlement of legal claims rather than a practical solution equally beneficial to both contestants. In the meantime the two parties have agreed to confer on the "Canal Water Dispute." Preliminary talks were held in Karachi in March, 1950, and negotiations are now being continued.

RIVER REGIMES

For the full understanding of a dispute such as this, relating to the division of a limited supply of water between two communities, it is necessary to have accurate information regarding the quantity of water available for dis-

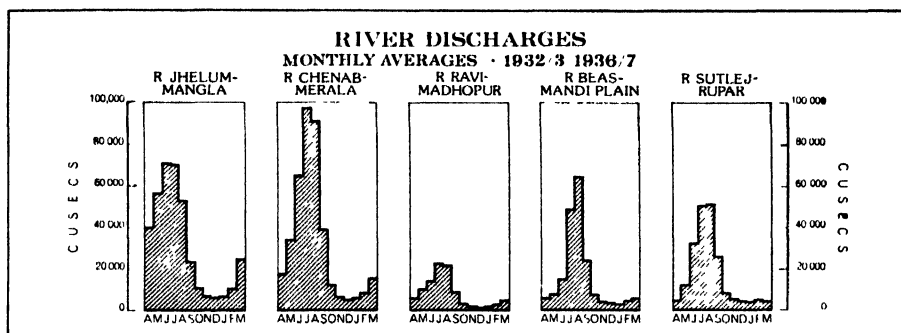


FIG. 3.—River discharges at five stations; monthly averages for the period 1932-33 to 1936-37.

tribution, the extent to which it is being apportioned in accordance with established custom, and the quantity, if any, which can be made available for further utilization. Obviously only the water that enters the rivers upstream of the highest canal headworks is of importance. Hence a brief examination of the Himalayan catchment areas of the Punjab rivers is essential (Fig. 1).

Of the five rivers, the Sutlej has the largest catchment area, about 18,500 square miles; then come the Jhelum, 13,000 square miles, and the Chenab, 10,500; the catchment areas of the Beas and the Ravi are considerably smaller, namely 5600 and 3100 square miles respectively.⁵ However, the average annual discharge of the rivers (Fig. 3) bears no relation to the size of the catch-

⁴ *Pakistan News*, Vol. 3, No. 44, Nov., 1949.

⁵ S. G. Burrard (later Sir Sidney Burrard) and H. H. Hayden: *A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet*, revised by Sir Sidney Burrard and A. M. Heron, Delhi, 1933, p. 175.

ment areas, except that the Ravi, the smallest river, has the smallest discharge. The Jhelum and the Chenab are approximately equal in volume of discharge, and each is greater than the Sutlej or the Beas. Per unit of area, however, the Chenab has the largest discharge, followed by the Jhelum, the Beas, and the Ravi; in relation to size of catchment basin, the Sutlej has by far the poorest discharge. But differences of annual flow have far less significance for irrigation engineers than the seasonal differences that reflect the incidence and variation of precipitation over the mountain catchment areas. Location in relation to major physiographic features is most important in this connection, since the amount of precipitation is affected by the trend of the main Himalayan ranges, which, extending from northwest to southeast, present barriers to the advancing southwest monsoon. It is difficult to draw regional distinctions in the amount of precipitation received, but four regions may be tentatively distinguished:

1. In the hilly country south of the Pir Panjal and its continuation in the Dhaoladhar average annual precipitation ranges from about 50 inches to 120 inches. Summer rainfall predominates throughout but is heaviest toward the southeast. Only toward the northwest are there significant winter and spring falls.

2. North of the Dhaoladhar and south of the Pir Panjal the few recording stations indicate a precipitation ranging from 40 to 60 inches; a larger proportion is received from the southwest monsoon than in the next region.

3. This region lies north of the Pir Panjal. Here winter and spring precipitation, derived from storms advancing from the west, makes up the greater part of a yearly total of 20 to 40 inches. Snowfall is particularly heavy on the Pir Panjal but decreases northward and eastward. Summer rainfall is meager, for the monsoon winds lose most of their moisture before reaching the region.

4. Finally, to the north of the Great Himalayan ranges precipitation is less than 22 inches. Data from the few existing stations indicate that it decreases from west to east, with a late winter maximum.

The differences between the annual and seasonal discharges of the rivers can be related to the degree of melting of ice and snow in the catchment areas as well as to the amount of precipitation, since rainfall in the plains, rapidly decreasing toward the southwest, has comparatively little influence on river flow, though it adds something to the volume and may even cause serious local flooding. Unfortunately, not much has been done in northern India in this field of research. Melting begins toward the end of March and forms the main source of water until June, when the summer monsoon rains set in. Variations in river flow during the spring raise problems for the irrigation engineers and point the necessity for more stations and for scien-

tific snow surveys. Of significance is the fact that the spring discharge of the Jhelum, and to a smaller extent of the Chenab, is much greater in relation to the winter discharge than that of the more easterly rivers.

From mid-June to the end of September river discharges are dependent on the summer rains and are everywhere large—10 to 16 times larger than the minimum monthly discharges. As was noted above, the hilly country south of the Pir Panjal and the Dhaoladhar has the heaviest summer rainfall; hence a river with a large part of its catchment area within this region is likely to have a greater summer discharge than one whose catchment area within the region is small. The greater summer flow of the Chenab as compared with the Jhelum is thus partly explained. The Chenab catchment basin includes a considerable area to the south of the Dhaoladhar, a large area between that range and the Pir Panjal, and only a small area farther north (Fig. 1), whereas much of the more extensive Jhelum catchment basin lies north of the Pir Panjal. The greater unit-area discharge of the Beas than of the Ravi can be similarly explained: a large part of the Ravi Valley lies north of the Dhaoladhar, a large part of the Beas Valley south of it. The summer flow of the Beas is in fact comparable with that of the much larger Sutlej, whose narrow valley between the plains and the Great Himalayan ranges presents a relatively small collecting ground in a zone of heavy rainfall, as compared with its wide uppermost section in the semiarid region north of the high ranges in Tibet.

In October the rivers begin to fall rapidly, and until February discharges are small. During the autumn the flow is still a result of the preceding summer monsoon rains. Winter discharges depend on precipitation that is mainly in the form of snow and are therefore meager, though rainfall in the Outer Himalayas, increasing westward, gives the Jhelum, the Chenab, and the Beas a more significant supply than the Ravi and the Sutlej.

DISTRIBUTION OF AVAILABLE WATER

The foregoing summary of river regimes is necessarily oversimplified, but it may serve to introduce consideration of the utilization of supplies. The territorial distribution of water by canals has been governed in part by the volume available, in part by the demand, and in part by agreement.

During the summer supplies are normally ample; any difficulties of distribution usually arise from the silting of weirs and canals or from scouring that diverts the main stream away from canal headworks. Demand for water is heaviest from late August to early December, for the maturing of *kharif* (autumn-harvested) crops and the sowing of *rabi* (spring-harvested) crops.

Unfortunately, during this time river supplies are rapidly decreasing. Throughout the remainder of the rabi season demand remains heavy and difficult to meet. By the end of April it has slackened, and supplies are beginning to increase. In periods of short supply the most efficient method of distribution is to give the full allotment to as many canals as possible for a limited time, usually 10 days, and thereafter run each canal at full capacity in a regular rotation. With linked canals and more than one taking off from the same river, an accurate regulation of flow at all headworks is necessary to ensure an equitable distribution of water. Traditional priority of use is a further complicating factor; for example, before partition the Upper Bari Doab Canal had first claim on the Ravi and the Sirhind Canal on the Sutlej. The working of the canals can best be illustrated by examining an annual "river account"; that for 1941-1942 has been selected.⁶

From mid-October to April the Sutlej was literally drained by the Sirhind Canal (Table I). Below the confluence with the Beas, Sutlej Valley canals take off from weirs at Ferozepore, Sulaimanke, and Islam. Several of the canals were designed for use in summer only and were therefore closed from mid-October to April or longer; the perennial canals, however, were entirely dependent on the contribution made by the Beas. Their rabi requirements (about 13,000 cusecs) far exceeded the supply, and thus the water spread on each unit of commanded area was considerably less than on older canals; and the amount left in the Sutlej at Adamwahan—that is, above the Chenab confluence—was negligible. During the spring the rivers rose, but supplies remained poor compared with those of the Jhelum and the Chenab, and relatively small for the area to be irrigated. Supply failed to meet the full allotted kharif capacity (29,600 cusecs), and because of daily fluctuations, concealed in monthly averages, only after the middle of June was it sufficient for all requirements. It remained sufficient until October, when flow rapidly decreased, and in the late kharif season there was a shortage. Briefly, then, the water supply of the Beas and the Sutlej is always fully utilized above the Chenab confluence except in July, August, and September, and because of water shortage the perennial canals have never achieved the success for which the Lower Jhelum and Lower Chenab Canals are justly famed.

On the Ravi the Upper Bari Doab Canal took all the available water in late October, November, and December, and the Lower Bari Doab Canal was entirely dependent on water transferred from the Chenab River by the Upper Chenab Canal (Table II). Downstream the Sidhnai Canal was like-

⁶ *Gauge and Discharge Data of the Rivers and Canals in the Punjab, 1941-42*, Government of the Punjab, Public Works Department, Lahore, 1946.

TABLES I-V—AVERAGE DAILY DISCHARGE OF RIVERS, OCT. 16, 1941—OCT. 15, 1942 (IN CUSECS)

TABLE I—BEAS AND SUTLEJ RIVERS

BEAS AND SUTLEJ RIVERS		OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Beas at Mandi Plain		6,834	5,092	4,610	4,350	6,998	7,447	8,950	9,539	13,259	67,166	129,574	65,456	13,761
Sutlej at Ruper		5,874	4,450	3,845	3,730	5,462	4,475	7,364	13,674	30,566	67,485	75,432	34,089	10,441
Sirhind Canal used		5,874	4,450	3,845	3,730	4,362	4,475	7,050	8,284	8,214	4,228	3,437	3,732	8,702
Supply { Beas component		7,137	5,305	4,810	4,710	6,979	7,860	9,062	9,028	12,164	57,533	109,800	53,067	13,943
at { Sutlej component		228	125	77	165	789	123	198	3,861	15,382	49,428	75,960	34,486	3,784
Harke { Total discharge		7,365	5,430	4,887	4,875	7,768	7,983	9,260	12,889	27,546	106,961	185,760	85,553	17,727
Canals at Ferozepore	Dipalpur	Closed	Closed	Closed	Closed	Closed	Closed	1,556	1,204	3,010	5,617	3,492	5,891	4,305
	Gang	1,727	1,210	1,149	766	1,191	1,556	794	1,047	1,505	2,449	1,545	2,597	2,104
	Eastern	Closed	Closed	Closed	Closed	Closed	Closed	646	482	1,428	2,187	1,312	2,146	2,111
	Total used	1,727	1,210	1,149	766	1,191	1,556	2,996	2,733	5,943	10,253	6,349	10,634	8,520
Canals at Sulaimanke	Pakpattan	2,451	1,705	1,483	1,242	1,683	2,375	1,026	2,312	2,674	5,262	3,515	5,925	2,881
	Sadigia	3,181	2,406	1,773	1,507	2,214	3,009	2,584	2,895	2,869	4,587	2,790	4,841	2,167
	Fordwah	Closed	Closed	Closed	Closed	Closed	Closed	Closed	689	1,025	3,065	1,850	3,120	2,376
	Total used	5,632	4,111	3,256	2,749	3,897	5,384	3,610	5,896	6,568	12,914	8,155	13,886	7,424
Supply above Islam		773	335	588	874	1,086	633	1,374	1,938	5,897	55,089	165,097	65,745	5,925
Canals at Islam	Mailsi	Closed	Closed	Closed	Closed	Closed	Closed	882	1,246	1,811	3,079	2,356	3,938	2,909
	Bahawal	828	356	461	733	657	852	479	369	2,182	5,077	3,284	4,603	3,402
	Qaimpur	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	17	431	276	486	149
	Total used	828	356	461	733	657	852	1,361	1,615	4,010	8,587	5,916	9,027	6,460
Discharge at Adamwahan		99	59	37	112	13	3	Nil	Nil	Nil	34,647	136,612	61,038	2,561

TABLE II—RAVI RIVER

RAVI RIVER	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Madhopur	2,559	1,899	2,035	2,104	5,939	7,634	9,953	10,366	11,238	28,136	34,741	17,686	5,673
Upper Bari Doab Canal used	2,559	1,899	2,035	1,315	3,102	4,022	6,071	6,879	6,902	4,126	2,666	4,187	5,333
Degh Nullah	88	71	100	117	311	193	63	118	126	629	1,922	1,642	228
Ravi above Ballolki	562	362	1,114	1,158	3,873	3,338	3,033	2,318	1,051	16,577	44,930	22,631	3,056
Upper Chenab Canal	5,517	3,501	2,233	4,534	3,800	3,168	5,010	5,950	6,773	3,816	3,520	4,692	5,837
Total	6,079	3,923	3,347	5,692	7,673	6,506	8,043	8,268	7,824	20,393	48,450	27,323	8,893
Lower Bari Doab Canal used	6,062	3,845	3,070	5,333	3,993	5,415	6,261	6,738	6,714	5,871	4,370	6,696	6,565
Sidhnai	6	Nil	Nil	55	1,184	911	800	908	198	7,101	30,598	25,471	4,306
Haveli Canal	3,726	2,124	1,924	741	2,014	1,935	1,707	3,021	3,943	12	Nil	Nil	Nil
Total	3,732	2,124	1,924	796	3,198	2,846	2,507	3,929	4,141	10,309	30,610	25,471	4,306
Sidhnai Canals used	3,636	2,066	1,813	748	2,001	1,838	1,838	3,401	3,876	2,340	2,567	2,981	3,501
Discharge below Sidhnai	71	Nil	111	48	1,197	755	669	528	265	7,972	28,043	22,490	805

TABLE III—CHENAB RIVER

CHENAB RIVER	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Marala	10,259	6,954	8,892	9,992	19,286	19,860	27,706	39,521	54,746	90,132	113,601	57,250	14,970
Upper Chenab Canal used	7,562	4,385	3,841	5,926	4,060	5,054	6,922	10,288	11,926	8,098	9,220	10,376	11,382
Upper Jhelum Canal	5,592	4,636	3,764	6,068	6,003	6,274	5,112	2,446	3,418	4,546	5,183	4,892	6,511
Total at Khanki	8,778	7,343	9,622	10,697	22,664	21,396	25,081	29,131	40,519	91,123	105,458	54,068	12,266
Lower Chenab Canal used	8,682	7,174	5,951	6,575	6,937	9,214	9,632	10,989	10,802	9,999	9,797	11,404	11,626
Supply { Jhelum component	2,784	1,688	1,332	3,749	13,041	20,307	37,903	57,217	44,239	63,784	45,084	25,663	7,857
at { Chenab component	3,251	1,339	2,514	3,664	9,261	11,891	12,897	16,098	20,560	90,175	109,178	47,634	6,729
Trimmu { Total	6,035	2,427	3,846	7,413	22,302	32,198	50,810	73,315	64,799	153,959	154,262	73,297	14,586
Canals at { Rangpur used	884	Closed	Closed	Closed	Closed	Closed	212	882	1,324	1,275	1,361	1,421	1,442
Trimmu { Haveli used	4,315	2,359	2,103	873	2,238	2,139	1,909	3,613	4,785	3,660	659	634	730
Supply { Chenab component	5,575	2,376	2,553	6,118	13,512	28,811	41,832	60,172	46,649	120,356	161,730	115,032	22,650
at { Sutlej component	149	94	62	139	14	3	3	Nil	Nil	27,133	115,348	65,678	25,541
Panjnad { Total	5,724	2,470	2,615	6,257	13,526	28,814	41,835	60,172	46,649	150,509	279,078	180,710	25,191
Canals at { Abasia used	42	Closed	Closed	Closed	Closed	Closed	38	156	240	224	190	256	257
Panjnad { Panjnad used	5,454	1,528	985	1,076	1,502	1,443	2,381	5,327	7,880	7,123	5,370	8,250	8,139

NOTE: Discharge of the joint river Chenab-Sutlej (i.e. the Panjnad River) into the Indus is given in Table V.

TABLE IV—JHELUM RIVER

JHELUM RIVER	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Mangla	10,133	6,955	8,877	11,252	23,725	33,325	52,793	68,539	58,861	64,496	52,929	32,052	15,417
Upper Jhelum Canal used	7,507	6,344	6,073	7,333	7,707	7,775	7,413	5,079	7,497	8,273	8,305	8,349	8,939
Rasul	3,930	1,905	4,087	6,217	22,028	28,893	48,807	65,456	54,446	64,655	49,229	28,074	7,173
Lower Jhelum Canal used*	3,676	1,877	3,063	848	2,216	3,323	2,537	3,451	3,583	3,394	3,089	3,599	3,848

*NOTE. Discharge downstream is given as the Jhelum component of "Supply at Trimmu" in Table III.

TABLE V—INDUS RIVER

INDUS RIVER	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
Kalabagh	48,603	30,227	28,820	34,004	45,810	55,352	84,884	107,521	252,149	559,812	394,009	181,153	61,414
Panjnad at Dhaka	1,641	1,614	2,206	4,994	N.T.*	28,151	N.T.	N.T.	N.T.	N.T.	N.T.	N.T.	N.T.
Indus at Mithankot	56,424	36,842	31,793	40,565	53,375	75,618	111,616	N.T.	N.T.	N.T.	N.T.	N.T.	N.T.
Indus above Sukkur	56,905	38,244	32,885	39,436	47,306	67,149	97,557	176,500	170,707	432,406	421,526	250,812	71,688

*Not taken.

TABLE VI—RIVER DISCHARGES: MONTHLY AVERAGES, 1932/33 TO 1936/37

REGIME	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
Sutlej above Rupar	8,743	5,721	4,692	4,381	4,581	4,475	5,000	13,085	32,571	54,685	55,784	26,180
Beas above Mandi Plain	8,992	5,115	4,316	4,264	5,003	6,100	6,333	8,738	15,304	48,619	64,389	8,992
Ravi above Madihopur	3,793	2,225	1,887	2,206	3,351	5,492	6,357	10,453	14,664	23,057	22,591	9,155
Chenab above Marala	12,789	7,203	6,089	6,256	9,051	15,840	17,632	34,665	65,318	97,728	91,210	39,210
Jhelum above Mangla	11,064	7,590	7,187	7,077	11,007	25,031	39,758	56,067	71,626	70,069	52,796	23,685

wise dependent on Chenab water delivered by the Haveli Canal. This dependence on the Chenab continued into June, since the Upper Bari Doab Canal still used most of the Ravi flow and downstream from Madhopur losses from evaporation were high. Although in summer average flow in the Ravi is good, there are violent daily fluctuations, and the Upper Chenab Canal ensures the smooth working of the Lower Bari Doab.

The precarious position of the canals taking off from the Ravi and the Sutlej in West Punjab is apparent, and the fear of the reduced flow that would follow increased withdrawals from the Ravi, the Beas, and the Sutlej in East Punjab is readily understandable. It is plain that if in East Punjab the Beas were tapped to irrigate parts of the Bist-Jullundur Doab and the Sutlej dammed to supplement supplies to the Sirhind, Eastern, and Gang Canals, a large area in Multan and Montgomery Districts and Bahawalpur State in West Punjab would inevitably suffer a serious water shortage.

The question arises whether alternative sources could be made available for irrigation in this area. Since expense precludes the widespread introduction of tube wells, water can come only from the Jhelum and the Chenab, possibly by way of the Raya Branch of the Upper Chenab Canal. Some Chenab water already reaches the Nili Bar Colony on the Pakpattan Canal, now linked with the Lower Bari Doab, and with necessary modifications of canal capacities the configuration and relative heights of the doabs would permit an increased transfer of Chenab water into the southern part of Multan and Montgomery Districts, though it would be impossible to command the entire area now irrigated by the Dipalpur Canal.

Such a development, however, would naturally depend on the availability of water in the two northern rivers. The "river accounts" of the Chenab and the Jhelum show that there is none to spare during the critical autumn months (Tables III and IV). In 1941-1942 the natural flow was abundant in spring and summer, but from mid-October to mid-January practically the whole Jhelum discharge was taken by the Upper and Lower Jhelum Canals, the larger part by the Upper Canal, which delivered more than half of it to the Chenab. The experience of 20 years indicates that a full allocation for the two canals cannot be guaranteed between mid-October and mid-February.⁷

Water in the Chenab, including deliveries from the Jhelum, was fully utilized by the Upper and Lower Chenab Canals in October and November, and there was little to spare in early winter; observations over a longer

⁷ "Technical Review, 1925," *Technical Paper*, Class A, No. 28, Government of the Punjab, Public Works Department, Irrigation Branch, Lahore, 1926.

period show that the two canals, even with a full quota from the Upper Jhelum Canal, cannot usually be run to full capacity from September to April. Even if the Jhelum quota were increased in early October, January, February, and March, a shortage would remain in late October, November, and December. Hence there appears to be little prospect that the Chenab and the Jhelum could contribute more water than at present to reduce future shortages in the Ravi and Sutlej Rivers. In any case, further withdrawals from either river would have to be carefully considered in relation to the possible effect on the canals downstream.

At first thought it might seem that increased withdrawal must adversely affect the canals taking off from the Chenab at Trimmu (i.e. below its confluence with the Jhelum) and from the Panjnad (i.e. the Sutlej below its confluence with the Chenab). However, the statistics show that in the critical months from October to the end of December the water available at Trimmu and Panjnad must be derived mainly from seepage back to the Chenab and the Jhelum, since they are virtually drained of their water at Khanki and Rasul and the contributions of the Ravi and the Sutlej are negligible. Thus it is doubtful whether the supply at Trimmu and Panjnad would be affected by increased withdrawals upstream.

POSSIBLE SOLUTIONS

The fundamental fact emerges that the natural flow of the five rivers was already fully utilized before partition. There is little hope, so far as the writer can judge, that West Punjab will be able to find alternative supplies within the present boundaries to irrigate the area on the Sutlej Valley Canals should the natural flow of the Sutlej and the Beas be diminished by further withdrawals in East Punjab. The intensity of irrigation in the Jech and Rechna Doabs could undoubtedly be reduced and the water thus saved be distributed south of the Ravi, but this is no real solution to the problem.

There is one possible way out - the construction of reservoirs in the upper valleys of the Chenab and the Jhelum to store surplus summer flow for use in autumn and winter. It is to safeguard her right to carry out such projects that Pakistan is vitally concerned with the outcome of the Kashmir question; moreover, it must be emphasized that in the first 16 miles of its course the Upper Jhelum Canal itself lies in Kashmir, though in an attempt to avoid this an alternative alignment was seriously considered at the time the project was formulated. Political control over Kashmir would also enable Pakistan to ensure that nothing interfered with the natural storage of water—for example, exploitation of forests and overgrazing—so

as to prevent soil erosion and rapid runoff in summer, which reduce seepage back to the rivers in autumn.

Although the difficulties of constructing dams in the Himalayas are formidable, engineers have been planning storage schemes to give more water to the canals that need it most, namely those dependent on the Beas and the Sutlej. Work is now proceeding on the Bhakhra Dam Project, prepared in 1919 and authorized in 1945. The dam will impound the Sutlej 40 miles above Rupar; the original intention was to carry irrigation into the Bist-Jullundur Doab and to extend the Sirhind Canal into the southeastern Punjab, Ferozepore, and Patiala, which now lie in East Punjab. It was also proposed to construct a dam across the Beas at Larji to nourish the Sutlej Valley Canals, and to transfer water from the Chandra tributary of the Chenab by tunnels through the Pir Panjal Range into the Beas and the Ravi. Near the Rohtang Pass in Kangra District relative heights in the rivers would permit a four-mile tunnel at about 10,000 feet above mean sea level to divert water into the Beas; and near the Marhu Pass in Chamba State a five-mile tunnel at about 7700 feet above mean sea level could transfer water into the Ravi.⁸

It remains to be seen whether India will carry out the projects for the Marhu and Rohtang tunnels and the dam across the Beas, the additional water to be used not as originally intended but entirely within East Punjab. The possible accession of Kashmir to Pakistan cannot affect any of these schemes, since they all lie outside that state. Moreover, the feasibility cannot be ignored of extending canal irrigation, admittedly on a comparatively small scale, in the valleys of the Jhelum and the Chenab in Kashmir, and if any such scheme should reduce the flow of water reaching West Punjab in the critical months when the rivers are rising or falling, the construction of reservoirs in Kashmir to meet West Punjab's needs would become all the more urgent.

THE ROLE OF THE INDUS

Any analysis of river utilization in the Punjab would be incomplete without brief reference to the Indus.⁹ As early as 1900 plans were made to irrigate the Thal, the semiarid steppe of the Sind-Sagar Doab, with water drawn from the Indus, but they were never carried out; and after the Sukkur barrage in Sind was completed in 1927, further use of the Indus and its tribu-

⁸ See *Administration Rept. 1943-44*, Government of the Punjab, Public Works Department, Irrigation Branch, Lahore, 1946.

⁹ The Himalayan catchment area of the Indus River is 103,800 square miles (Burrard and Hayden, *loc. cit.*).

taries upstream was sanctioned only after most careful consideration of observed discharges had proved that the flow reaching Sukkur would not be reduced. When the Government of India sanctioned small withdrawals, a barrage was begun, before 1939, across the Indus at Kalabagh. After a long interruption it was completed in 1946, and early in 1947 the Thal Canal was opened. Fortunately for Pakistan, it is difficult to envisage any large-scale irrigation project in, or diversion of Indus water from, the upper valley in Kashmir or Tibet that might threaten supplies for canals in the Punjab or Sind. Also, apprehensions that increased withdrawals in East Punjab might lead to serious repercussions in Sind seem to have little foundation. "River accounts" of the Indus before 1947 showed that the contribution made by the Punjab tributaries was only a small proportion of the total in the critical months of October, November, and December (Table V). Though the autumn and winter flow of the Indus is much larger than that of any of its feeders (the 1941-1942 "account" does not reveal the amount, a maximum of 6000 cusecs, used by the Thal Canal), there is no water to spare, and transfer of Indus water across the Thal to a point on the Jhelum high enough upstream to be of value to the older canals is precluded by the relief of the land and by the need to safeguard irrigation interests in Sind.

THE PHYTOGEOGRAPHICAL ZONES OF PALESTINE

R. O. WHYTE

A FEW years ago the author was commissioned to survey the fodder problem in Cyprus and Palestine and suggest how the available resources might be improved in relation to the demands of the livestock population.¹ In order to appraise the possibilities of managing the natural vegetation for greater fodder production, it was necessary to study the ecological relationships of the various types of vegetation and therefore, as a preliminary, to review the work of the late Professor A. Eig and the other botanists of the Hebrew University, Jerusalem. That work has been primarily concerned with establishing the phytogeographical relationship of Palestine (within the political boundaries before the State of Israel was formed) with the other countries bordering the eastern Mediterranean. The Jewish botanists have produced an interpretation different from that of the older European phytogeographers or the more recent Russian school. It regards Palestine and parts of the adjacent countries as a meeting place of some of the world's major phytogeographical groups.

DENUDATION AND REGENERATION OF VEGETATION

Visitors to countries of the eastern Mediterranean cannot fail to be impressed by the many bare, rocky hillsides, almost devoid of vegetation. It is hard to believe that most of these hills were once well covered with a characteristic vegetation. The bare hills of Judea, for example, were clothed with a luxuriant forest and shrub vegetation, which was removed over a long period for building, fuel, and charcoal burning. Over these denuded areas now range flocks of sheep and goats, preventing any regeneration of the natural cover. It is frequently argued that the goat is responsible for the so-called "goat deserts" of the Middle East, but actually the goat is the final factor in the sequence of destruction and denudation; and it is the first that must be removed before regeneration to anything approaching the original plant cover is possible.

A certain number of experimental areas in Palestine have been protected

¹ R. O. Whyte: The Fodder Resources of Palestine: A Report [to the Palestine Government] of a Survey Made in Autumn 1945 and Spring 1946, Jerusalem, 1948 (noted in the *Geographical Review*, Vol. 39, 1949, pp. 331-332); *idem*: The Provision of Fodder in a Mediterranean Environment, *Journ. British Grassland Soc.*, Vol. 4, 1949, pp. 33-45.

► DR. WHYTE, formerly Director of the Commonwealth Bureau of Pastures and Field Crops, Aberystwyth, Wales, is now associated with British Field Products Ltd. Among his well-known works is "Vanishing Lands" (with G. V. Jacks), 1939, a study of world erosion.

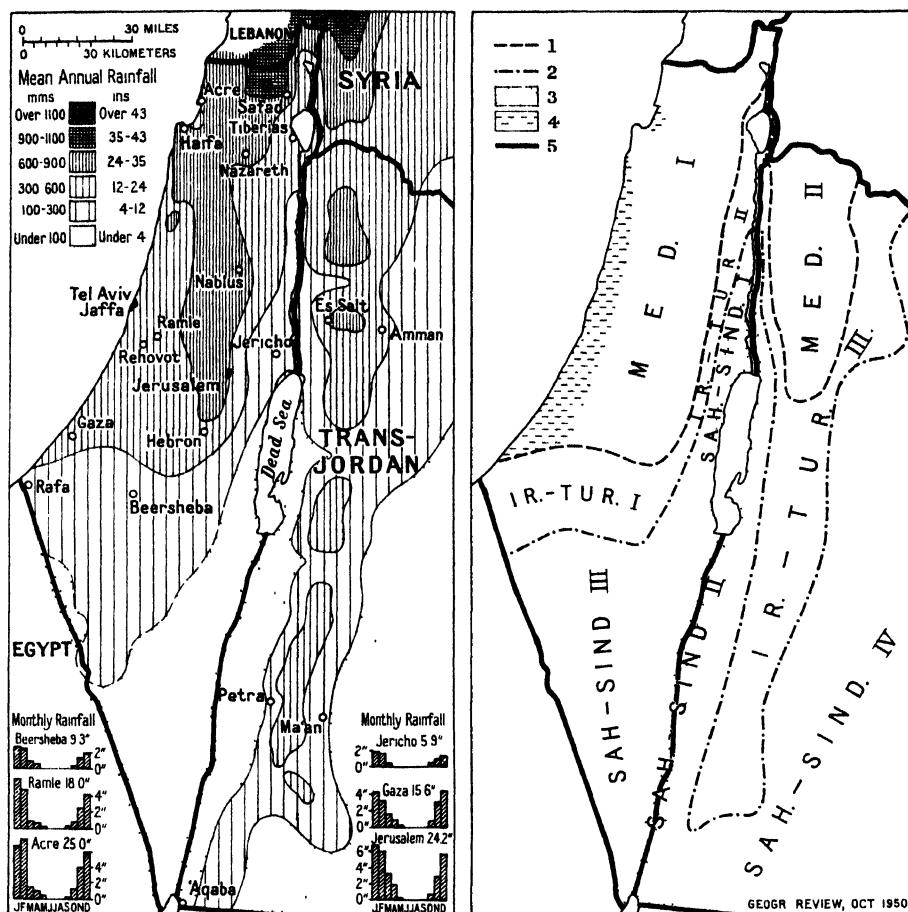


FIG. 1.—Rainfall map of Palestine, with graphs of monthly rainfall at six selected stations.

FIG. 2.—Phytogeographical zones of Palestine, after Eig: Mediterranean (I, Cisjordan, II, Transjordan), Irano-Turanian (I, Judean Desert; II, Near Negeb, III, Transjordan), and Saharo-Sindian (I, Lower Jordan Valley; II, Wadi 'Araba; III, Far Negeb; IV, Transjordan).

Key: 1, boundary between Mediterranean and Irano-Turanian zones; 2, boundary between Irano-Turanian and Saharo-Sindian zones; 3, principal area of occurrence of Sudano-Deccanian enclaves; 4, area of Saharo-Sindian penetrations; 5, pre-partition international boundaries.

from all use for periods as long as 20 years. These are located at places such as Mt. Tabor, Umm Safa, and Ein Arrub. The capacity of the natural species to regenerate in a relatively short time is remarkable. If all the bare, rocky hills of Palestine, at least on the western slopes, could be freed from burning, cutting, and grazing for 20 years, they would become covered with a vegetation of the garigue or maquis type, within which some of the original tree species might eventually become established. It is from areas such as these, and from the few relicts of old associations still existing in particularly

avored localities, that it has been possible to piece together a picture of the original vegetation cover of Palestine.

In the early days several of Palestine's neighbors lacked timber resources. It is probable that Palestine supplied ancient Egypt before that country began to look to the Lebanon for its timber; in the third millennium before Christ, Mesopotamia may also have depended on Palestine and other countries along its western border. Various other factors, including a succession of invasions and settlements, contributed to the denudation; only where beautiful old oaks and terebinth trees, isolated or in groves, have been regarded as "sacred trees" can an indication of the true nature of the ancient and climax vegetation be obtained. Further evidence is furnished by the scores of villages, wadis, and hills bearing the names of trees and forests that have long since disappeared from the locality. It is therefore primarily on the basis of historical, bibliographical, and plant-relict data that it is possible to re-create a picture of the climax vegetation of Palestine, and for that matter of all the ancient lands and islands of the eastern Mediterranean.

CLIMATIC RELATIONS

Something should first be said about the climatic characteristics of Palestine and their relation to those of the Mediterranean region as a whole. Figure 1 gives the mean annual rainfall in Palestine and adjacent areas, and, more important, the monthly distribution at six representative stations. It will be seen that Palestine conforms to the characteristic pattern of the "Mediterranean" climate—winter rainfall, summer drought.

The comparatively high average annual rainfall (24.2 inches at Jerusalem) is largely attributable to the cyclonic depressions that originate over the Atlantic and move eastward, and this cyclonic origin is also the cause of the high degree of uncertainty in the rainfall regime. The warm indraft of air in front of the cyclones, the sirocco or khamsin of Syria and Palestine, occurs locally in all seasons except summer but is especially important in spring, when cyclones are vigorous.

The contribution of dew to the total amount of moisture available to plants has been reviewed recently by Ashbel.² Certain characteristics of distribution possibly have some relation to the botanical composition of the plant associations; for example, the Negeb is poorest in rainfall but richest in dewfall, whereas in the hill regions the opposite conditions prevail.

The natural vegetation of a winter-rainfall environment belongs to two

² D. Ashbel: Frequency and Distribution of Dew in Palestine, *Geogr. Rev.*, Vol. 39, 1949, pp. 291-297. See also the note "Dew in Palestine," *Geogr. Rev.*, Vol. 40, 1950, pp. 144-145.

main types: deep-rooted perennial trees or sclerophyllous shrubs adapted to withstand the long summer drought; and quick-growing annual grasses, legumes, and other herbs capable of growing and producing seeds within the period of winter rainfall and lower temperatures. Such a region is therefore suitable for the dry-land cultivation of winter-annual crops. If, as in the coastal plain of Palestine, water is available for irrigation throughout the year, high yields per acre may be obtained. In the Mediterranean region the true perennial mesophytic grasses of northern Europe do not appear until one reaches an elevation of 2000 feet (in Cyprus) or the northern fringe of the true Mediterranean environment (on the Palestine-Lebanon border); in both these areas one finds types of *Lolium perenne* and *Dactylis glomerata*. The Mediterranean environment also contains, possibly as intrusions from a steppe climate, some extremely drought-resistant bunch grasses, which, although having the desirable perennial character, are unpalatable to livestock.

ENGLER'S PHYTOGEOGRAPHICAL REGIONS

Before proceeding to Eig's subdivisions, let us consider the older classification of Engler.³ Engler recognized five major plant kingdoms of the world, the first of which, the northern extratropical or boreal, included the Mediterranean region as a subdivision.

In the Mediterranean region Engler recognizes the well-known perennial sclerophyllous evergreen forms that no longer belong to the arcto-tertiary element, since they are not found in the Tertiary deposits of the present Arctic region; however, several of these forms existed at one time in the region in which the boreal flora is now dominant, so that Engler calls the element which distinguishes the Mediterranean flora "tertiary-boreal." He states that the Mediterranean flora must have lost some of its original character because of progressive extension of the xerophytic area. In the southwest of the Mediterranean region more of the original character is retained, but in the east the steppe element has so gained the upper hand that the plant cover has acquired a habit very similar to that of the Central Asian and southern steppe lands.

Within the Mediterranean region Engler recognizes six provinces: Southwest Mediterranean; Iberian; Ligurian-Tyrrhenian; Central Mediterranean; Armenian-Iranian Mediterranean; Southern Mediterranean. He classifies Syria, with the Lebanon and Palestine, in the Central Mediterranean

³ A. Engler: Übersicht über die Florenreiche und Florengebiete der Erde, in Syllabus der Pflanzenfamilien, by A. Engler and E. Gilg, 8th edit., Appendix, pp. 352-364.

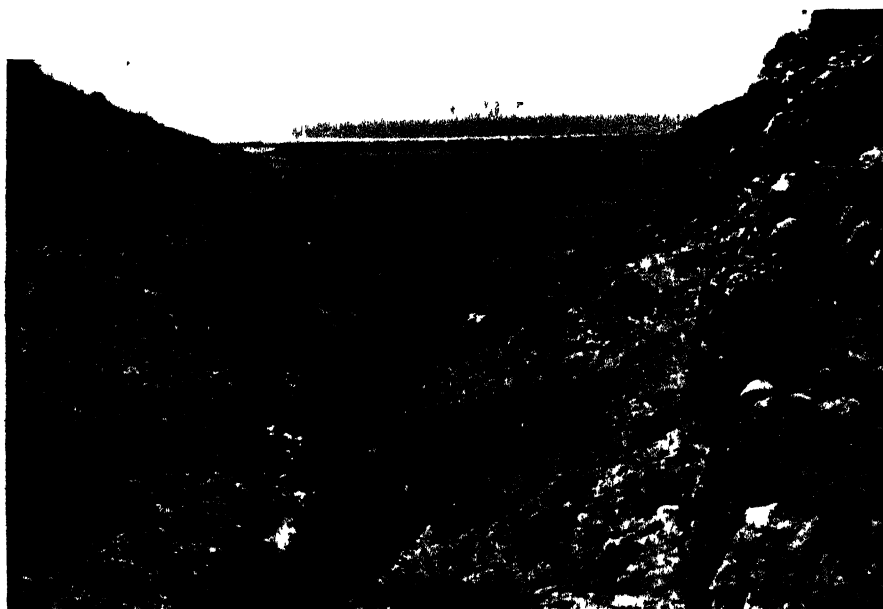


FIG 3—Garigue association on Mt Carmel (All photographs in this article have been supplied by members of the faculty of the Hebrew University, Jerusalem)



FIG 4—Remnant of *Pinus halepensis* forest near Beit Mahsir village, mountains of Judea

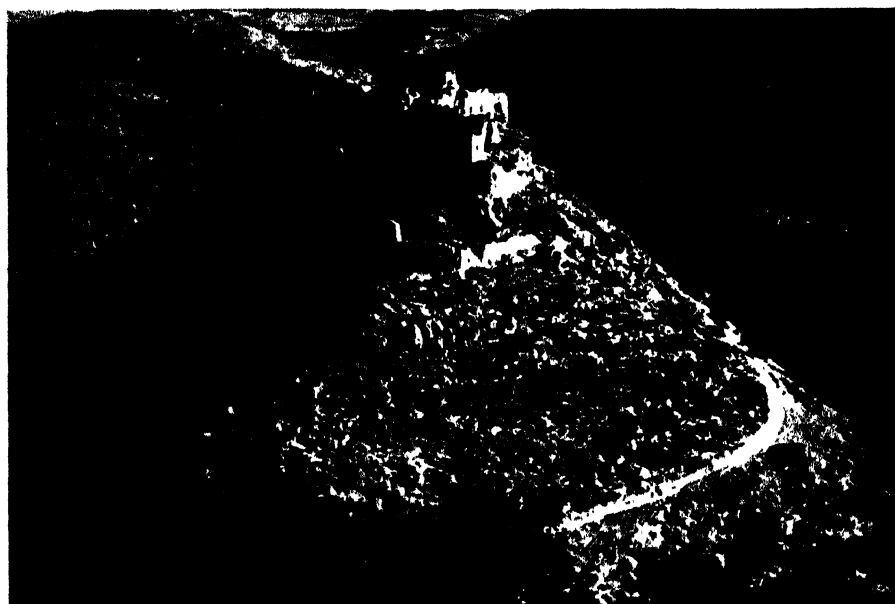


FIG. 5—Maqui of the *Quercus calliprinos*-*Distacia palaestina* association, in the vicinity of Montfort Castle, Upper Galilee.

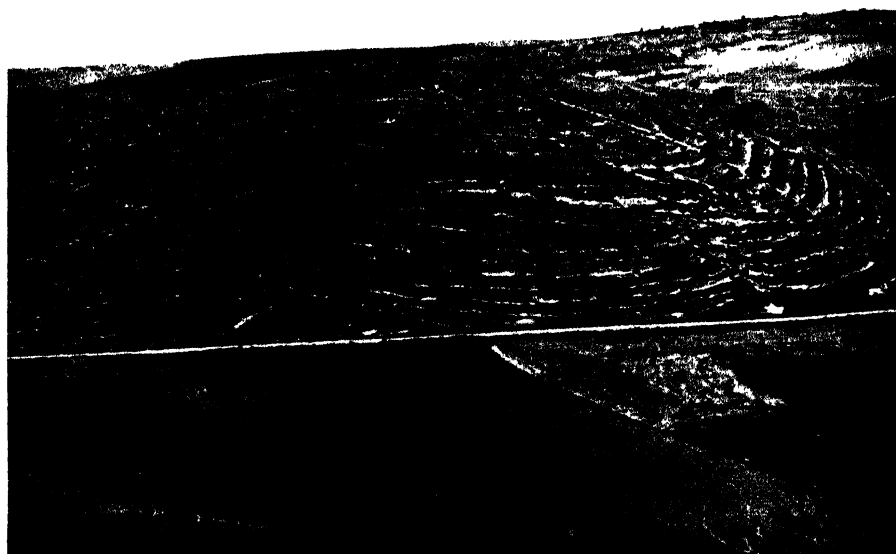


FIG. 6—*Quercetum ithaburensis*, near Bat-Shlomo village, southwestern part of Mt. Carmel.

province. There is no indication of the boundary within Palestine itself between the Central Mediterranean province and the Armenian-Iranian province, or between the Mediterranean region and the Central Asian region; this latter region becomes gradually transformed toward its western side into the Armenian-Iranian province of the Mediterranean region.

PHYTOGEOGRAPHICAL SUBDIVISIONS OF PALESTINE

In his first extensive published work, on "Les éléments et les groupes phytogéographiques auxiliaires dans la flore palestinienne," Eig⁴ provided the following foreword, which summarizes the objective of his work:

Traveling some 200 km. in Palestine from north to south, one goes from the majestic Hermon massif, southern vanguard of the Lebanon, watered by 1000 to 1500 mm. of rainfall and covered in the north and west by beautiful Mediterranean vegetation, to the northern tip of the Sinaitic desert, faithful ally of the great Sahara. In crossing this classic country from west to east, in an average distance of 120 to 130 km., one goes from the Mediterranean, which waters the coastal plain of predominantly Mediterranean flora, into the Transjordan steppes and deserts, the western terminus of an immense hinterland, a steppe-desert back country of the Near East. The flora of the Mediterranean, of the Near East, and of the steppes and deserts of North Africa come together here in this little country that hardly covers 60 thousand sq. km., a good half of which is steppes and deserts. This fact is particularly interesting because Palestine is the only country where these three types of flora are in direct contact.

The delimitation in Palestine of the areas of the large natural phytogeographical regions, the study of the types of flora of these areas, of their reciprocal influences, and their affinities with parts of the phytogeographical regions surrounding Palestine, constitute the principal aim of the present work.

The memoir contains a map showing the extent of the three main subdivisions, namely Mediterranean, Irano-Turanian, and Saharo-Sindian; a revised version of this map was produced by Eig in 1938⁵ (Fig. 2), and by Zohary in 1947 (highly detailed),⁶ and a new map is reported to be in preparation at the Hebrew University.⁷ Eig states that the principal points

⁴ A. Eig: *Les éléments et les groupes phytogéographiques auxiliaires dans la flore palestinienne*, I: Texte; II, Tableaux analytiques, *Repertorium Specierum Novarum Regni Vegetabilis*, Beihefte, Vol. 63, No. 1, 1931, and No. 2, 1932.

⁵ A. Eig: On the Phytogeographical Subdivision of Palestine, *Palestine Journ. of Botany*, Jerusalem Ser., Vol. 1, 1938, pp. 4-12, map on p. 7.

⁶ M. Zohary: A Vegetation Map of Western Palestine, *Journ. of Ecology*, Vol. 34, 1947, pp. 1-19, map opp. p. 18. Professor Zohary's article is possibly the most readily available ecological account of the vegetation of Palestine. After introductory notes on the topography, climate, and soils of Palestine, he describes the phytogeographical subdivisions in a more detailed and botanical manner than the present author has attempted.

⁷ Hugo Boyko: Post War Situation of Plantsociological Research in Palestine, *Vegetatio*, Vol. 1, No. 1, 1948, pp. 74-75. A book on the "Vegetation of Palestine" is believed to be nearly finished and is to be published in the *Chronica Botanica* "New Series of Plant Science Books."

of advance in his later versions are "the more or less exact delimitation of the Irano-Turanian part of the Judean Desert (the Irano-Turanian enclave of Western Palestine); the clear phytogeographical subdivision of the Negeb; the much more exact phytogeographical subdivision of Transjordanian."

The phytogeographers of the Hebrew University assert that Palestine is the only country in which outliers of all three major types of vegetation can be found: (1) the Mediterranean, characteristic of the "Mediterranean environment," described above; (2) the Irano-Turanian, characteristic of Iran, Turkey, and adjacent lands; and (3) the Saharo-Sindian, characteristic of the great deserts of the Sahara and Arabia as far east as northwestern India and the Deccan. The three types are well seen about the Hebrew University, which is located on one of the summits of the Mount of Olives, and its vicinity. The university itself is set in characteristic Mediterranean vegetation, surrounded by a little wood of *Pinus halepensis* and a garden in which grow side by side without special care the Mediterranean cypresses and cedars, Australian *Eucalyptus*, Chinese *Ailanthus*, American *Schinus* and *Washingtonia*, and Indian *Melia*. Just outside the university grounds, between Jerusalem and Bethany on the road to the Dead Sea, are the solitudes of the Judean desert, which according to Eig is principally Irano-Turanian in its higher parts, but which is clearly Saharo-Sindian as one approaches the lower elevations; around the Dead Sea itself there is considered to be a Sudano-Deccanian enclave.

Looking across this northward extension of the Rift Valley of Africa, one can clearly see the same types in reverse order on the steep slopes of the mountains of Moab, particularly, as Eig remarks, a little before sunset. These mountains carry a Saharo-Sindian vegetation on the lower slopes, then a mixed vegetation in which the Irano-Turanian element is strongly represented; the highest parts, the oak forests of which are clearly visible from the Judean slopes, carry a typical "Mediterranean" vegetation. Just beyond the mountains of Moab, at some 7 to 20 miles from the summits, the great Irano-Turanian steppe region begins.

An interesting comparison has been made between this relation of vegetation zones and altitude in the mountains of Moab and a similar zonation in the massif of Hoggar in the central Sahara. In Hoggar, Maire⁸ recognizes three stages: from the plain to 1700-1800 meters, the tropical stage, which corresponds to Eig's Saharo-Sindian and Sudano-Deccanian; from this elevation to 2300-2400 meters, the lower Mediterranean stage,

⁸ René Maire: La végétation et la flore du Hoggar, *Comptes Rendus l'Acad. des Sci. [de Paris]*, Vol. 186, 1928, pp. 1680-1682.

which resembles the Mauritano-steppe vegetation and corresponds to Eig's Irano-Turanian element; and from 2400 meters to the summits (3000 meters), the upper Mediterranean stage, which corresponds to Eig's Mediterranean element.

The difference in the heights at which the various vegetation types occur in the mountains of Moab and the Hoggar massif is due to difference in latitude, nearness of other mountain masses, or nearness to the open Sahara.

LIMITS AND PHYSICAL CHARACTERISTICS OF THE ZONES

The geographical limits and chief physical characteristics of Eig's three zones will now be briefly outlined. As far as natural conditions are concerned, the Mediterranean region is the most distinct; it is remarkably homogeneous in its ecology, flora, and vegetation. Opinions differ, however, as to its exact limits. It is a question whether on the west the North African steppes should be included and whether on the east the coastal areas of the Mediterranean itself, with a shrub or forest climax, should be regarded as the limit or the region be extended to the heart of Asia, to Persia and Afghanistan or even farther, according to the views of Engler and other phytogeographers.

The limits of the Irano-Turanian region are also uncertain, particularly on the east. The question is whether it reaches the western limit of the Sino-Japanese region and includes "High Asia" or whether High Asia east of Afghanistan can be regarded as a separate region. In general, it may be said that the Irano-Turanian is limited on the west by the Mediterranean region, on the south by the Saharo-Sindian, on the north by the Euro-Siberian/Boreo-American, and on the east probably by the Sino-Japanese. The great physical diversity of the complex of countries that form this region and the richness of its flora are in direct contrast with the Saharo-Sindian region, and yet there is an almost complete absence of floristic or phytosociological works on this vast ensemble of steppe countries.

The Irano-Turanian region is distinguished by extreme diversity of surface relief—high plateaus, low plains, mountain chains—and by uniformity of climate: low precipitation and a long dry season; extreme variations in temperature; and two distinct annual pauses in vegetation growth, i.e. the hot, dry summer and the cold winter. A steppe vegetation prevails. The climaxes are dominated by grasses and dwarf shrubs. Other characteristics are an almost complete absence of forest climaxes or even climaxes of large shrubby species; an enormous development of certain systematic groups; a

richness of species; a large number of endemic species; a pronounced specialization of systematic groups higher than species.

From the Atlantic coast of Morocco to the deserts of Sind, Thar, and the Punjab there extends a vast region of deserts and steppes, the vegetations of which have many floristic and phytosociological characters in common. The climate of this Saharo-Sindian region is marked by extreme dryness of the air and enormous evaporation; high maximum and, frequently, low



FIG 7 - Association of *Artemision monosperma* on dunes of the coastal plain near Mishmar Hayam

FIG 8 Grass association of *Eragrostis bipinnata*-*Centaurea procurrens* in the Sharon Plain near Pardes Hanna The scattered trees are *Quercus ithaburens* remnants of the devastated Tabor oak forest

minimum temperatures, with wide diurnal range, and low precipitation. The soils are saline. The vegetation is characterized by great poverty in species, extreme poverty in individuals, marked monotony, in part of the region, rarity of climatic associations, which are replaced by edaphic, feeble development of systematic groups higher than species (no family or tribe can be regarded as characteristic), and the presence of a cultivated tree, the date palm.

THE MEDITERRANEAN VEGETATION ZONE

In the Mediterranean region⁹ the climax is or was forest, in Palestine itself the climax associations are that in which the Aleppo pine (*Pinus halepensis*) is found with *Hypericum serpyllifolium*, a type dominated by *Ceratonia siliqua* and *Pistacia lentiscus*, the *Quercetum ithaburensis*, a type dominated

⁹ On floral characteristics and relationships within the Mediterranean region see M. Rikli, *Das Pflanzenkleid der Mittelmeerländer*, 3 vols., 1943-1948.

by *Quercus calliprinos* and *Cretaegus azarolus*, and probably also a type of *Quercetum infectoriae*.¹⁰

Eig has published a paper on the remains of the Palestinian oak forests (*Quercus aegilops* ssp. *ithaburensis*).¹¹ Remnants of this forest are more numerous in western Palestine and are also found in Transjordan; apparently all references to "deciduous oaks" in old documents may be assumed to refer to this species. *Quercus infectoria* is comparatively rare in Transjordan, as in Cisjordan, but it is probable that a *Quercetum ithaburensis* alone or in mixture with *Quercetum calliprini* was once widely distributed in the northern and middle parts of Transjordan. Reports of travelers in former times indicate that, as in Palestine proper, a *Quercetum ithaburensis* occupied the lower ranges, especially on level ground with deep soils. At higher altitudes the *Pinetum halepensis* and *Quercetum calliprini* were to be found.

In the plain of Bashan the *Quercetum ithaburensis* seems to have advanced to the extreme eastern limit of the "Mediterranean" environment. The forests of Bashan were highly spoken of in ancient times: "Open thy doors, O Lebanon, that the fire may devour thy cedars. Howl, fir tree; for the cedar is fallen; because the mighty are spoiled; howl, O ye oaks of Bashan; for the forest of the vintage is come down" (Zechariah xi, 1-2). Even some 80 years ago, there were still remnants of these forests of Bashan; H. B. Tristram,¹² writing in 1866, remarked: "About four o'clock we emerged from the evergreen oak forest, and came upon the park-like scenery of Bashan, open, and beautifully studded with deciduous oaks, singly or in clumps."

Eig believes that the forests are now better preserved in Transjordan than in Palestine; nevertheless, the *Quercetum aegilops ithaburensis* was one of the most important climax associations in Palestine. In western Palestine it is thought once to have occupied the greater part, if not all, of the coastal plain as well as the Plain of Acre and at least the greater part of the Plain of Esdraelon. It also extended over much of the mountains of Samaria, part of Mt. Carmel, the greater part of Lower Galilee, part of Upper Galilee, and possibly part of the mountains of Judea.

As regards the other Mediterranean forest types of which traces are to be found in Palestine, there are only a few remnants of forests of *Pinus halepensis* and *Hypericum serpyllifolium* in western Palestine, especially in the

¹⁰ Eig, On the Phytogeographical Subdivision of Palestine (*op. cit.*), p. 5.

¹¹ A. Eig: A Historical-Phytosociological Essay on Palestinian Forests of *Quercus aegilops* L. ssp. *ithaburensis* (Desc.) in Past and Present, *Botan. Zentralblatt Beihefte*, Part 2, Vol. 51, 1933, pp. 225-272.

¹² H. B. Tristram: The Land of Israel; A Journal of Travels in Palestine, 2nd edit., London, 1866, p. 488.

southwestern part of Mt. Carmel; better examples are believed to occur in Transjordan. Remnants of the *Ceratonia siliqua*–*Pistacia lentiscus* forests can be seen along the seacoast and on the eastern slopes of the mountains of Samaria.

Forests of *Quercus infectoria* seem to have been rare in Palestine and could be found chiefly in Upper Galilee. Eig believes¹³ that forests of *Quercus calliprinos* and *Crataegus azarolus*, which can be recognized in Syria and the



FIG. 9—Batha of the *Poterietum spinosum* substeppical type, between Wadi Fara' and Bukaya on the eastern slope of the Judean desert.

Lebanon, once existed in Palestine and that they may be represented by the first degradation stage in the ecological succession, namely the maquis of *Quercus calliprinos* and *Pistacia palaestina*.

Throughout the Mediterranean lands can be seen these various types of vegetation, which actually represent stages of degradation of the climax vegetation caused by varying degrees and intensities of use and misuse by man. The first and second stages are generally called "maquis" and "garigue" respectively. Maquis is predominantly a shrub vegetation in which occur some representatives of the forest type from which it was derived and to which it might return if given adequate protection. Garigue is entirely a low shrub vegetation with few or no trees. Below garigue, Eig recognizes a further stage of degradation of climaxes, the "batha" formation,¹⁴ represented in Palestine by the most widely distributed Mediterranean association

¹³ Eig, On the Phytogeographical Subdivision of Palestine (*op. cit.*), p. 6.

¹⁴ A. Eig: On the Vegetation of Palestine, *Inst. of Agric. and Nat. Hist., Agric. Exper. Sta., Bull.* 7, Tel Aviv, 1927.



FIG 10—*Haloxylonetum persicae* in the southern parts of the Wadi 'Araba. *Haloxylon persicum* a shrub reaching a height of four meters is used for charcoal and camel fodder

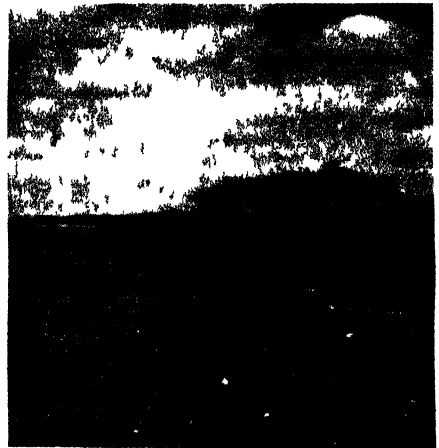


FIG 11—Association of *Anabasis articulata* *Zilla spinosa*, characteristic of the gravel plains of Wadi 'Araba. In the background, *Acaciaetosum tortilidis* Near Ghor el Ajram

FIG 12—In the gravel plains of the Saharo-Sindian region vegetation (here *Acacia spirocarpa*, *Zilla spinosa*, etc) is often limited to the wadis

of the country, the *Poterietum spinosi* in its several variations. On rockier ground the *Thymetum capitati* and *Fumanetum thymifoliae* are also rather common.

Given adequate protection and other favorable conditions, batha will change to garigue, garigue to maquis, and, ultimately, possibly even maquis to climax forest. But the ever-present and ever-increasing pressure of man and his ax, his plow, and his free-ranging grazing animals makes any such changes impossible except in isolated protected areas.

IRANO-TURANIAN VEGETATION ZONES

Eig recognizes three such zones in Palestine: the enclave of the Judean desert; the northern parts of the Negeb; and most of Transjordan west of the Hejaz Railway.

The enclave of the Judean desert stretches in a rather narrow strip along the eastern slopes of the mountains of Samaria and Judea, from the Sea of Galilee to the Negeb near Beersheba. Compressed as it is between the Mediterranean territory of western Palestine and the Saharo-Sindian territory of the lower Jordan Valley and its mountain slopes, this Irano-Turanian strip has little opportunity for typical development in form and composition and contains frequent intrusions of plants from the adjacent vegetation zones.

Of the great semidesert area known as the Negeb, the northernmost part is subject to dry farming by the Bedouin Arab tribes; barley is now cultivated largely by mechanized deep-plowing methods in a cereal-fallow rotation. It is therefore difficult to distinguish the natural vegetation, but Eig believes this to have been predominantly *Artemisia Herba-alba*.

Three principal subdivisions can be provisionally recognized in the Irano-Turanian zone of Transjordan. In the north are vestiges of the Irano-Turanian open forest of *Pistacia atlantica*; the middle and largest subdivision is characterized by various associations dominated by *Artemisia Herba-alba*; the third subdivision is the high plateau west and southwest of Ma'an, characterized by vestiges of a type of open forest in which *Juniperus phoenicea* grows together with *Artemisia Herba-alba*. Another interesting association is one composed of *A. Herba-alba* and *Astragalus adpressiusculus* in which groups of *Crataegus azarolus* may be found here and there. Those interested in the history of the vegetation of Transjordan may find valuable evidence in the existence on this plateau of specimens of *Hedera helix* and *Prunus prostrata* in addition to the species of *Astragalus* mentioned above. Also of

interest in this connection are observations made in the Anglo-Egyptian Sudan.¹⁵

SAHARO-SINDIAN VEGETATION ZONES

Eig recognizes¹⁶ four typical areas in Palestine: the lower Jordan Valley and adjacent mountain slopes; the Wadi 'Araba; the far Negeb; the areas in Transjordan. The banks of the Jordan are clothed chiefly by a riparian forest of *Populus euphratica*, the valley plains by associations of *Suaeda palaestina* and *Salsola tetrandra*, the near-by mountains by *Suaeda asphalatica* and other species.

The climax associations in the Wadi 'Araba are few and poorly developed, and it is difficult to recognize associations or their dominant species.

The southern parts of the Negeb have little or no vegetation; in the north the climax association dominated by *Zygophyllum dumosum* is the most prominent.

In the Saharo-Sindian territory of Transjordan, halophytic species such as *Haloxylon articulatum*, *Chenolea arabica*, and *Salsola tetrandra* are among the most common.

The work already done on the phytogeography of Palestine underlines the importance of continuing exploration. For example, the Irano-Turanian region may prove to be one of the most important gene centers for a number of economic plants, particularly for the herbage grasses and legumes that have become of economic importance throughout the temperate world. It was the late N. I. Vavilov who developed the concept of the concentration of genes (the units of heredity located in the chromosomes) in certain central areas, which areas still display the greatest wealth and variety of forms of the cultivated species in question, and often also of their wild relatives. These areas, containing large numbers of forms unknown in any other region, are also regarded as "primary centres of form origination," marked by the presence of dominant characters. Both the multiplicity of forms and the dominant characters diminish on passing away from these centers. In consequence of these laws, "gene hunting" has become a specialized branch of plant breeding and one of great agricultural importance. Many breeders of herbage plants, for example in Great Britain and Australia, would stand to gain from plant exploration and collection, particularly in the Irano-Turanian and adjacent phytogeographical regions.

¹⁵ The Report of the Soil Conservation Committee, Sudan Government, 1948.

¹⁶ Eig, On the Phytogeographical Subdivision of Palestine (*op. cit.*), p. 9.

CLIMATE AND ZONAL DIVISIONS OF THE BOREAL FOREST FORMATION IN EASTERN CANADA*

F. KENNETH HARE

THE boreal forest formation is the great belt of coniferous forest stretching across the subarctic latitudes of Eurasia and North America. Perhaps because of its inaccessibility and unsuitability for permanent rural settlement, the boreal forest has been little studied by geographers in North America, though Russian and Scandinavian workers have devoted much time to it. The phytogeographer and the ecologist have been concerned primarily with the southern part of the formation, which is the main home of the lumbering industries of Canada, Scandinavia, and the U.S.S.R. The greater part of the formation, beyond the limit of merchantable trees, has received scant attention.

The idea that the boreal forest consists of an endless repetition of muskeg and forest, with little difference from one place to another, is a popular delusion. In both Eurasia and eastern North America the formation resolves itself naturally into three or four zonal divisions, each with its characteristic type of cover and each standing in a definite and predictable relationship to climate. This paper is devoted to a study of these zonal divisions in Canada east of the Ontario-Manitoba boundary, and particularly in the great Labrador-Ungava peninsula, where the author himself has worked.

Labrador-Ungava offers many advantages to the student of the zonal structure of the boreal forest. The peninsula is essentially a tilted peneplain, relatively low in latitude 58° (near the Arctic tree line) but rising southward to a general level approaching 3000 feet some 50 to 100 miles north of the St. Lawrence. Toward the river it falls in a spectacular and highly complex escarpment, the Laurentide scarp, which has yet to appear on most contour maps of North America. The southward rise of altitude has the effect of offsetting to some extent the normal southward rise of temperature. The thermally controlled zonal divisions of the boreal forest are hence widened and can be studied over much greater distances than in Russia or Finland.

*The author wishes to express his gratitude to Dr. Ilmar Hustich, pioneer of forest studies in Labrador, to Dr. Pierre Dansereau of the department of botany, University of Michigan, and to Mr. Harry Lash of the department of geography, McGill University, for advice and assistance in the preparation of this paper.

► DR. HARE, formerly a research climatologist with the British Meteorological Office, is now chairman of the department of geography at McGill University, Montreal.

The same is true on a smaller scale between Hudson Bay and Lake Superior.

A further advantage springs from the fact that the entire eastern half of the Canadian boreal forest has an abundant precipitation. Control of growth by temperature, well known to be the usual climatic control of natural vegetation in high latitudes, is thus manifested in full measure. Drought effects such as those reported by Marie Sanderson in western Canada are unknown.¹

The boreal forest formation in eastern Canada, as elsewhere, is bounded on the north by the tundra. On the south, it passes into a mixed forest formation, the Great Lakes-St. Lawrence Forest of Halliday² or the Lake Forest of Weaver and Clements.³ A similar mixed forest borders the Russian boreal forest west of the Urals. As with the zonal divisions of the boreal forest itself, both the southern and northern limits are readily determinable in climatological terms.

COMPOSITION

The chief associations of the formation are dominated by white spruce (*Picea glauca*), black spruce (*P. mariana*), larch or tamarack (*Larix laricina*), and balsam fir (*Abies balsamea*). The jack pine (*Pinus banksiana*) is also an important element in the western half of the region. Tree lines of these species are given in Figure 1, but a discussion of their climatic relations is not attempted in this paper.

The black spruce, white spruce, and tamarack have almost identical northern tree lines, and all three range throughout the formation in North America, though the tamarack is rare in Alaska. Their relative abundance, however, varies greatly. In Labrador-Ungava, black spruce is overwhelmingly the most common. In northern and central districts it occurs either alone or in association with tamarack; in the south and southeast black spruce-balsam fir is the principal association.

Balsam fir and jack pine have northern tree lines for which no exact climatic equivalent can be found. The jack pine, for example, has made little progress into Labrador-Ungava, in spite of apparently favorable climate.

Associated with the dominant coniferous species is a small group of hardwoods having a widespread distribution in the boreal forest in both

¹ Marie Sanderson: Drought in the Canadian Northwest, *Geogr. Rev.*, Vol. 38, 1948, pp. 289-299.

² W. E. D. Halliday: A Forest Classification for Canada, *Dominion Forest Service Bull.* 89, Ottawa, 1937.

³ J. E. Weaver and F. E. Clements: *Plant Ecology*, 2nd edit., New York and London, 1938, pp. 496-500.

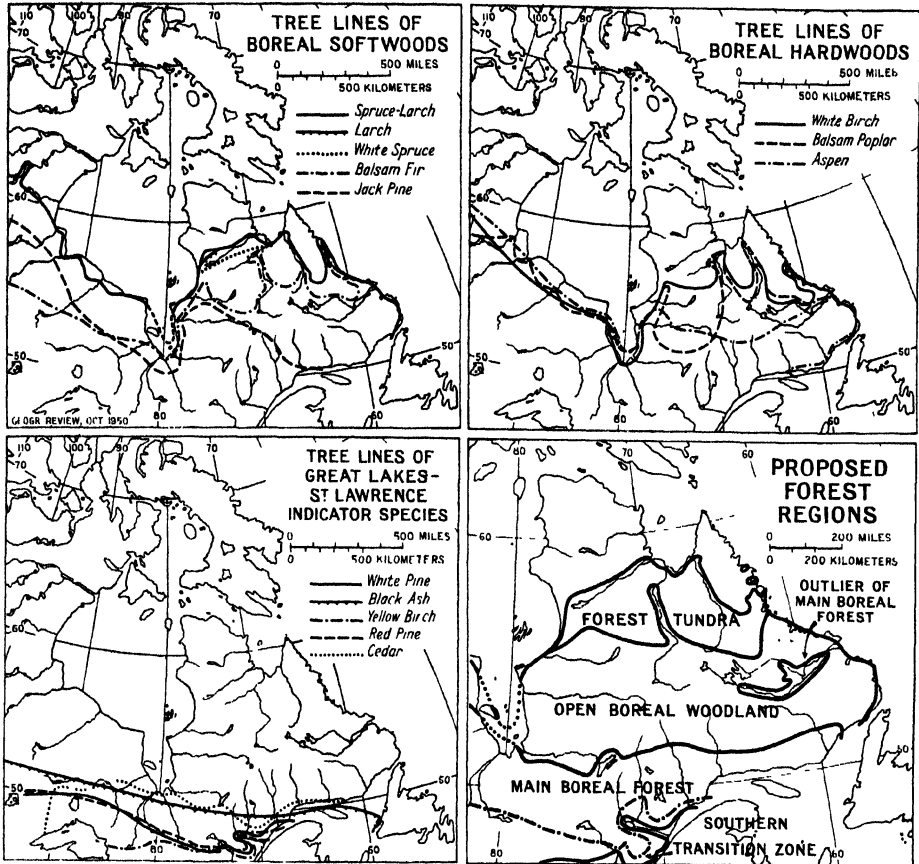


FIG. 1—Tree lines of boreal softwoods. Note absence of the jack pine from much of Labrador-Ungava. The two spruces and the larch have coincident tree lines in most places.

FIG. 2—Tree lines of boreal hardwoods. Note limited extent of aspen in Labrador-Ungava.

FIG. 3—Tree lines of species typical of the Great Lakes-St. Lawrence mixed forest formation. Two species, the cedar and the black ash, invade the main boreal forest.

FIG. 4—Proposed zonal divisions of the boreal forest in Labrador-Ungava. The term "region" is applicable because the map was originally drawn to establish natural regions in the peninsula; "zonal division" is a better term as applied to the boreal forest as a whole. The classification closely follows that of Hustich, but the terminology and the position of boundaries are revised. "Southern transition zone" refers to the ecotone between the boreal and Great Lakes-St. Lawrence forests.

North America and Eurasia, though the actual species differ between the two land masses. The North American representatives are the white birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), aspen (*Populus tremuloides*), and certain alders (*Alnus* spp.). None of these trees form part of the climax, but all are important elements in the successions. Their tree lines are shown in Figure 2.

Birch and aspen attain their greatest significance in areas recently burned.

Huge areas of birch-aspen associates⁴ extend today over the fire-devastated parts of Labrador-Ungava and northern Ontario. Beneath the pale-green foliage of the hardwoods, spruce, larch, and fir seedlings grow rapidly, and in a few decades the climax coniferous association is re-established. Figure 5 shows the succession on the flood-plain bluffs of the Hamilton River in Labrador. White birch and aspen also occur as individual relict trees in the coniferous associations (Fig. 8), though aspen does not appear in northern Labrador-Ungava.

Balsam poplar occurs widely throughout the region, though it is always local in distribution. The alders are found almost exclusively along water-courses and lake shores, forming impenetrable thickets through which landings can hardly be forced.

Along the southern margins of the formation the boreal forest is invaded by isolated individuals or groves of species proper to the Great Lakes-St. Lawrence mixed forest formation. Among the softwoods, these include the white cedar or arbor vitae (*Thuja occidentalis*), white pine (*Pinus strobus*, a dominant species of the mixed forest), and red pine (*P. resinosa*). The hardwoods include black ash (*Fraxinus nigra*), yellow birch (*Betula lutea*), and bigtooth aspen (*Populus grandidentata*). The cedar and black ash invade the boreal forest deeply, but the others penetrate only a short distance. Tree lines of most of these species are shown in Figure 3. At the southern limit of the boreal forest, white and red pines and sugar maple become dominants.

FOREST TYPES

The boreal forest formation is not readily divisible into associations, as is the deciduous forest. Partly because of the small number of species, partly because the region has been heavily glaciated and hence suffers from deranged drainage and highly variable soils, the forest exhibits structural types rather than fixed associations. These types differ as to the spacing of trees, the layering of the vegetation, and the nature of the ground cover. Many of them are definitely not "climax" and probably represent successional stages that must soon give way to a higher form of forest. The principles of succession in the boreal forest are, however, too vaguely understood to allow a genetic classification. Accordingly the forest types are ranked as equals in the following discussion, regardless of their status.

The classification of forest types used here is based on a study by the

⁴ An "associates" is the successional equivalent of "association." The birch-aspen communities of the boreal forest are short-lived, yielding place to the coniferous forest that is climax in the formation; hence the use of "associates" rather than associations.



FIG. 5.—Birch-aspen associates on old burn, flood-plain bluff of the Hamilton River. The birch-aspen community serves as a cover beneath which the black spruce climax is regenerating.



FIG. 6—Close-forest stand of black spruce near Alexander Lake, in the Lake Melville Basin, growing on rough ground moraine. Note the close spacing of the trees and the deep shade of the floor. This is the most common forest type of the main boreal forest.

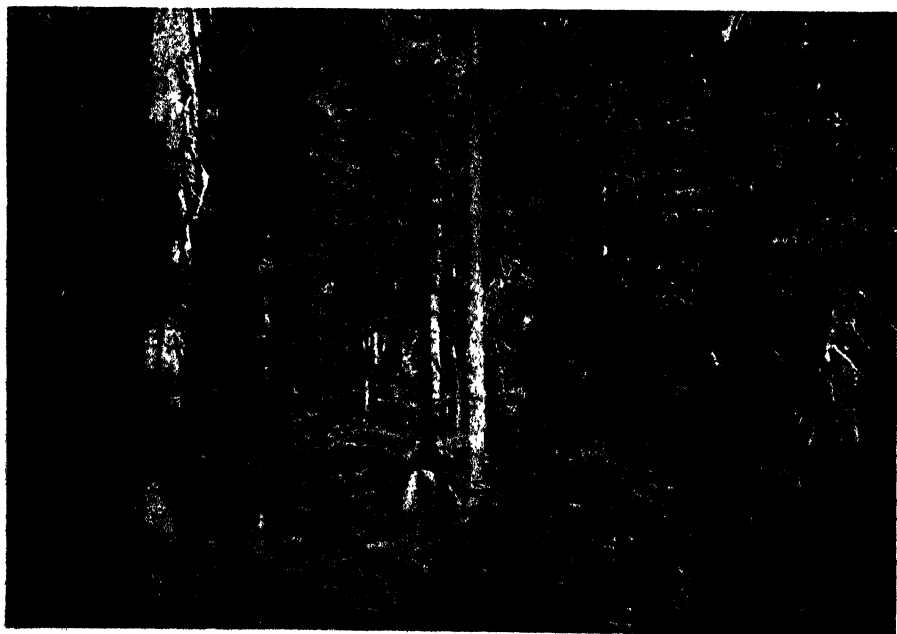


FIG. 7—Interior view of the close-forest shown in Figure 6. Young spruces, feather mosses, and a few small herbs cover the deeply shaded floor.



FIG. 8 Lichen-woodland—characteristic forest type of the open boreal woodland—on the sand plain of the Hamilton River delta. Black spruce is the only conifer; its candelabrum shape due to a special form of lateral branching. Relict white birch on right. Rich and unbroken *Cladonia* lichen floor.



FIG. 9—Another view of the lichen-woodland forest on the sand plains. Dwarf birch occurs as a shrub here, and the dominant spruces are widely spaced.

Finnish ecologist Hustich.⁵ He has studied both the Labrador and the Scandinavian-Finnish boreal forest, and his classification for the Labrador-Ungava region can be cross-referred to both the Russian taiga and the forests of western Canada as studied by Raup.⁶ Hustich's detailed subdivisions are not considered here, and new English terms are suggested for the main types. These are three in number:

1. The *close-forest* type ("Moist Series" of Hustich) is a continuous stand of closely spaced trees, in Labrador-Ungava usually a black spruce-balsam fir association. Such stands occur on well-drained land with a water-retentive soil and hence with abundant but not excessive moisture. The ground vegetation is rich in mosses, especially feather mosses, and there are some characteristic small herbs such as bunchberry (*Cornus canadensis*) and wood sorrel (*Oxalis montana*). Figures 6 and 7 show the exterior and interior of a typical specimen area, in this case a solid stand of black spruce.

2. The *lichen-woodland* type ("Dry Series" of Hustich) consists of open stands of trees with a thick and beautiful floor of lichens. Black and white spruce, tamarack, and jack pine all occur in such woodland, though the spruces are overwhelmingly the dominants. The lichen floor consists of a layer several inches thick of the pale-gray, purple, orange, or green fruiting bodies of *Cladonia*, the genus to which the so-called "reindeer mosses" belong. The trees are from 2 to 25 yards apart. Black spruce tends to assume a beautiful "candelabrum" form in the lichen-woodlands. This type occurs only on drier sites in the south but is widespread in central and northern districts. Various subtypes of lichen-woodland probably cover more than 60 per cent of the Labrador-Ungava plateau and are widespread throughout the formation in North America and Eurasia. Figures 8 and 9 show representative aspects of this type, though they do scant justice to its beauty. The term "woodland" is used to suggest the wide spacing of the trees.

3. The *muskeg* type ("Wet Series" of Hustich) occurs on badly drained ground and is variable in appearance. Black spruce and, to a smaller extent, tamarack are the typical trees. Both are slow-growing and slow-reproducing, appearing like gaunt sticks often largely devoid of branches or green leaves. The wet ground is covered by sphagnum mosses and certain shrubs, of which Labrador tea (*Ledum groenlandicum*), leatherleaf (*Chamaedaphne calyculata*), and a heath (*Kalmia angustifolia*) are representative.

⁵ Ilmari Hustich: On the Forest Geography of the Labrador Peninsula: A Preliminary Synthesis, *Acta Geographica*, Vol. 10, No. 2, 1949; reference on pp. 36-42.

⁶ H. M. Raup: Phytogeographic Studies in the Athabaska-Great Slave Lake Region, II, *Journ. Arnold Arboretum*, Vol. 27, 1946, pp. 1-85.

These clear-cut forest types occur throughout the formation in eastern Canada. The zonal divisions about to be discussed are definable in terms of the relative frequency of the forest types. This important principle has only recently emerged as the basis of division in the boreal forest.

THE ZONAL DIVISIONS

We come now to the first of the two main purposes of this article—the definition of zonal divisions within the formation. The argument closely

TABLE I—PROPOSED ZONAL DIVISIONS OF THE BOREAL FOREST IN LABRADOR-UNGAVA

ZONAL DIVISION	HUSTICH'S TERM	DOMINANT FOREST TYPE
Forest-Tundra Ecotone	Forest-Tundra	Thin lichen-woodland in valleys; pure tundra on interflaves
Open Boreal Woodland	Taiga	Lichen-woodland
Main Boreal Forest	Southern Spruce Forests	Close-forest
Boreal-Mixed Forest Ecotone	—	Close-forest containing Great Lakes St. Lawrence indicators

parallels that of Hustich, who laid down major forest regions for Labrador-Ungava in 1949.⁷ The basis of definition and the precise limits of the divisions proposed here differ significantly from his. In the next section the climatic relations of each of the divisions are reviewed.

South of the tundra four zonal divisions are proposed. These are arranged in north-south sequence in Table I.

The proposed zonal boundaries in Labrador-Ungava are shown in Figure 4. Where these differ from those of Hustich, the differences are based on an inspection of aerial photographs, on flights across the boundary zones, and in a few cases on ground traverses. The map is in any case provisional and will demand continual revision.

The dominant forest types refer to areas of well-drained soil. Throughout the formation areas of poor drainage are covered by treeless swamps and muskegs that differ little from zone to zone. The detailed character of the cover in each zone is beyond the scope of this report, but some further description is necessary.

The *forest-tundra ecotone* extends across northern Labrador-Ungava from the Hudson Bay coast to the Atlantic. Here it is truncated by the pure coastal tundra, which runs along the Atlantic shore to the Strait of Belle Isle. Along the line of the Torngat uplift, running north-south just east of the George River, the ecotone is narrow and is displaced southward by the

⁷ Hustich, *op. cit.*, pp. 47-53, Figs. 19 and 20. See also his "Phytogeographical Regions of Labrador," *Arctic*, Vol. 2, 1949, pp. 36-42, especially Fig. 4.

greater altitude. The forest-tundra ecotone⁸ is the zone in which associations of the tundra and boreal forest formations intermingle. The boreal forest is represented by long strings of lichen woodland along the chief rivers, but the interfluves are covered by pure tundra entirely free of trees. Permafrost is widespread throughout the zone. The northern limit is the Arctic tree line. The southern, the line along which the lichen-woodland covers interfluves as well as valley floors, is known with some confidence from traverses by Rousseau on the George River,⁹ Low on the Kaniapiskau River,¹⁰ and Polunin at Lac Bienville.¹¹ The present author was also able to traverse the boundary by air near the headwaters of the Whale River.

The *open boreal woodland* as a term seems preferable to Hustich's "taiga," since the latter is applied by Russian ecologists to the entire formation and is so understood by geographers everywhere. As the present term implies, this zone is dominated by enormous stretches of the lichen-woodland forest type; tall and well-developed spruce (more rarely other conifers) stand several yards apart in a sea of *Cladonia*. On the wetter ground muskeg supervenes, with stunted trees, Labrador tea, and sphagnum. Close-forest types are absent over most of the zone but become abundant on steeply sloping ground near the southern boundary. This boundary—one of the most significant economic limits on the continent, as it is the virtual northern limit of lumbering—is defined as that along which close-forest exceeds lichen-woodland in area.

The open boreal woodland presents one of the most picturesque, colorful, and extensive landscapes of the continent and is equally important in the Eurasian boreal forest. The beauty of its *Cladonia* floor, which retains the impress of footprints for years and whose pastel shades defy the color film, is still largely unknown to North Americans, since convenient routes nowhere penetrate its solitudes.

The *main boreal forest* is far better known, for it yields more than 90 per cent of the pulpwood cut of eastern Canada. Along its entire length it is penetrated by railways, logging roads, and power-generating rivers. In

⁸ The term "forest tundra" is a literal translation of the Russian term *lyesotundra* for the same belt in European Russia and Siberia. "Forest-tundra ecotone," a preferable form in English, was introduced by J. W. Marr: Ecology of the Forest Tundra Ecotone on the East Coast of Hudson Bay, *Ecological Monographs*, Vol. 17, 1948, pp. 117-144.

⁹ J. J. Rousseau: The Vegetation and Life Zones of George River, Eastern Ungava and the Welfare of the Natives, *Arctic*, Vol. 1, 1948, pp. 93-96.

¹⁰ A. P. Low: Report on Explorations in the Labrador Peninsula . . . , *Ann. Rept. Geol. Survey of Canada*, Vol. 8 (N.S.), Ottawa, 1895, Rept. L, p. 153.

¹¹ Nicholas Polunin: Report on Botanical Explorations in Arctic America, 1946-48, *Arctic*, Vol. 2, 1949, pp. 45-47.

eastern Canada it extends from north of Lake Superior across southern Labrador-Ungava to Anticosti Island and Newfoundland. Large outliers cover inland Gaspé, the highlands of New Brunswick, and parts of Maine.

This zone is largely covered by close-forest associations of black spruce and balsam fir east of Lake St. John, white spruce and balsam fir to the west, thus approaching the traditionally accepted boreal climax. Lichen-woodlands occur only on dry soils and appear to be a late stage of the xerosere.¹² Muskeg, with black spruce and tamarack as dominants, is again common, especially on the dreary plains south and west of James Bay (Fig. 10).

The northern limit of this zone was first defined by Halliday,¹³ who consolidated traverse records from many transverse valleys crossing the boundary. Hustich accepted Halliday's line with few exceptions.¹⁴ An accurate determination of its position on the Romaine River by H. N. Lash and N. Drummond showed, however, that Hustich's line was too far north.¹⁵ The position given on Figure 4 incorporates their results.

An important outlier of the main boreal forest covers the lowlands around the head of Lake Melville and in the Hamilton Valley. This favored region of Labrador has much close-forest, though lichen-woodland (Figs. 8 and 9) is extensive on sand plains and gravels. It was formerly believed that the richness of this vegetation sprang from the deeper and more fertile soils developed on the Proterozoic sediments contained in the basin. It is now obvious, however, that this outlier is a climatic effect, a subject treated below. A revised version of Halliday's map¹⁶ includes another outlier, the middle Kaniapiskau Valley, on the strongly folded Proterozoic sediments of the Labrador Trough. Here the vegetation consists of lichen-woodland and is included in the open boreal woodland of Figure 4.

The southern limit of the main boreal forest is the line along which the white pine-maple associations of the Great Lakes-St. Lawrence mixed forest formation replace the spruce-fir of the boreal forest. The position of this boundary as shown on Figure 4 is taken without change from "Native Trees of Canada."¹⁷ The Lake St. John basin forms a conspicuous enclave of Great Lakes-St. Lawrence associations within the main boreal forest.

¹² The succession of covers achieved as the forest extends over dry surfaces like rocky outcrops or sand plains, which abound in this region.

¹³ Halliday, *op. cit.*, See map in folder.

¹⁴ Hustich, On the Forest Geography of the Labrador Peninsula, *op. cit.*, Figs. 19 and 20.

¹⁵ Lash and Drummond made a traverse along Romaine River to determine ground control for the ecological interpretation of aerial photographs. The traverse, as yet unpublished, was carried out as part of a project directed by the present author. Mr. Lash has now assumed control of this project.

¹⁶ Native Trees of Canada, *Forest Service Bull.* 61, 4th ed., Ottawa, 1949. See map inside covers.

¹⁷ *Ibid.*

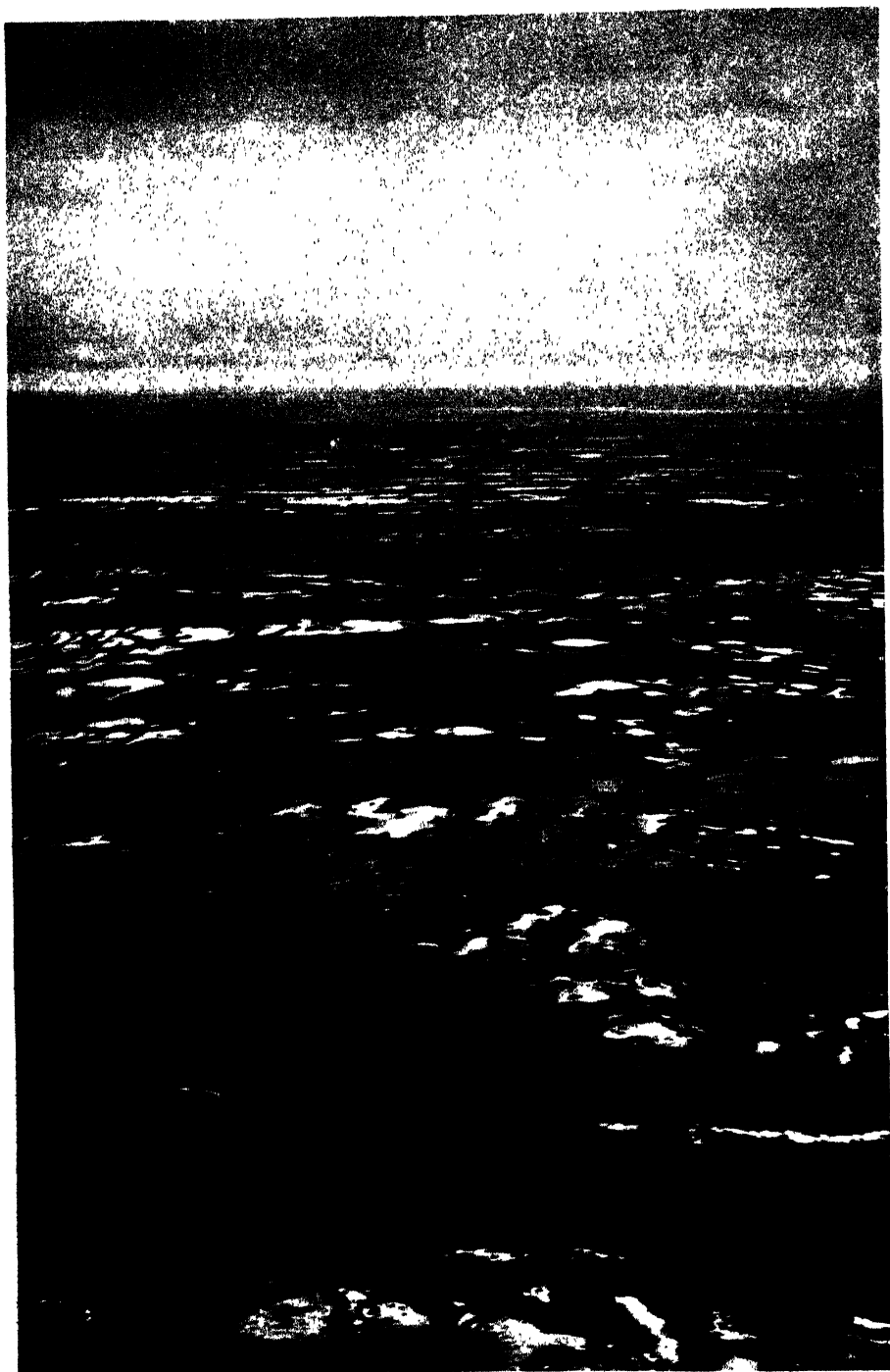


FIG. 10—Aerial view of the interminable muskegs south and west of James Bay.

The ecotone between these two formations is less easy to define than the forest-tundra. On Figure 4 the northern edge of the ecotone is taken as the tree line of white and red pine. However, certain elements of the Great Lakes-St. Lawrence forest, notably the white cedar and black ash, extend well beyond this line.

CLIMATIC RELATIONS

Climatic correlation has been impossible in the past because of the lack of inland climatological stations. Not until 1937 was a station established in the interior of Labrador-Ungava, a region equal in area to the United States east of the Mississippi and south of latitude 40° N. Since then, however, many stations have been opened by the Canadian Department of Transport and the United States Air Weather Service, and a rudimentary climatological network is now in operation. In 1947 the author began preparation of a report on the climatology of the region, and extensive use has been made below of materials gathered during this investigation.

Raw climatic data have little application in ecoclimatology. Effort must be made to find means of combining and integrating the elements into indices having a more direct applicability to ecological problems. The best available system is C. W. Thornthwaite's classification of 1948,¹⁸ and it is used here. An account of the climates of Canada as a whole according to this new classification has already been published by Sanderson.¹⁹ A considerably denser network of stations (see Appendix) has been used in the preparation of Figures 11 and 12, however, and these maps differ in detail from those of Sanderson.

Annual potential evapotranspiration is the function used by Thornthwaite to establish the degree of thermal efficiency possessed by a climate. It is an accumulating logarithmic function of monthly mean temperatures, regarded as expressing thermal efficiency on the basis of a presumed analogy with the control of growth rates by temperature.

Figure 11 shows annual potential evapotranspiration over eastern Canada and the boundaries of the thermal provinces suggested by Thornthwaite. The D'/C'_1 boundary runs north of Baker Lake, across the Ungava Peninsula from Portland Promontory to Payne Bay, and across the northernmost part of the Torngat massif. The C'_1/C'_2 boundary (separating cooler and

¹⁸ C. W. Thornthwaite: An Approach Toward a Rational Classification of Climate, *Geogr. Rev.*, Vol. 38, 1948, pp. 55-94. A more general treatment of the climate is given by F. Kenneth Hare: The Climate of the Eastern Canadian Arctic and Sub-Arctic and Its Influence on Accessibility, 2 vols., Montreal, 1950. (Doctoral Diss., unpublished.)

¹⁹ Marie Sanderson: The Climates of Canada According to the New Thornthwaite Classification, *Scientific Agric.*, Vol. 28, 1948, pp. 501-517.

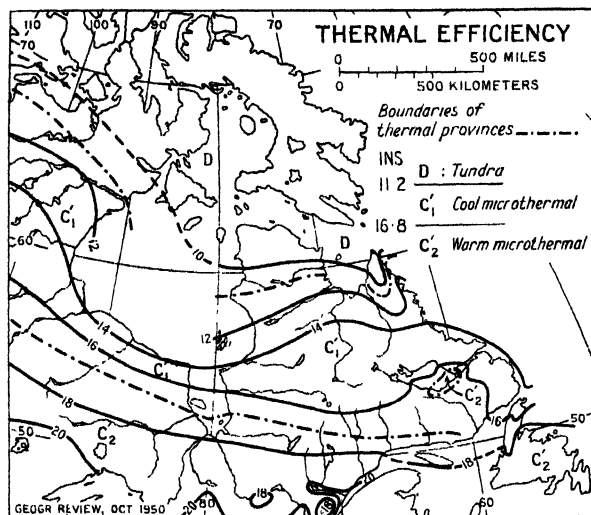


FIG. 11.—Thermal efficiency, expressed in terms of potential evapotranspiration (in inches), according to Thornthwaite's classification of 1948.

warmer microthermal provinces) runs from the Hayes River near Gods Lake across James Bay to the northern tip of the Long Peninsula of Newfoundland. Thus the greater part of Labrador-Ungava falls into the cool microthermal province (C_1). All the southern districts lie in the warm microthermal province (C_2); mesothermal climates do not occur

within the area of Figure 11, though they are found in the St. Lawrence lowlands near Montreal.

The records from Goose Bay airport show that an important outlier of warm microthermal climate occurs around the head of Lake Melville and the lower Hamilton Valley. Fragmentary records from North West River and the Hamilton Valley confirm that this is an extensive area, but its form can at present only be sketched in relation to the terrain (Fig. 11).

The moisture index, the other main element in Thornthwaite's classification, is shown in Figure 12. Labrador-Ungava, Newfoundland, and northern Ontario have an abundant well-distributed precipitation and rank almost exclusively as humid or perhumid. The southern half of Labrador-Ungava has indices of more than 100 (A; perhumid), as does most of Newfoundland. Highest values occur along the Laurentide scarp belt, just north of the Gulf of St. Lawrence, and in southern Newfoundland. Conspicuously drier areas include the structural depressions of Lake St. John and Lake Melville, and also the Atlantic coastal strip from Nain to Cape Harrison. Farther north and west indices are lower but everywhere exceed 20, except in the James Bay and Ungava Bay depressions. This is in striking contrast to the condition reported for the western boreal forest by Sanderson,²⁰ who found indices ranging from below -20 to about +20, i.e. between arid and moist subhumid.

²⁰ Sanderson, Drought in the Canadian Northwest, *op. cit.*

There is some doubt about the extent of drought in the James Bay region. The isopleth of 20 in the center is based on values computed for Fort Albany (17), Moose Factory (19), and Fort George (33). It is possible, however, that these values are too low, perhaps because of faulty exposure of the snow-measuring site. More recent observations at Moosonee, a first-order station staffed by trained professional observers, indicate a heavier winter snowfall than at near-by Moose Factory, and the index stands at 74. The point is academic, since almost the entire district is covered by muskeg in which bad drainage upsets the normal moisture cycle.

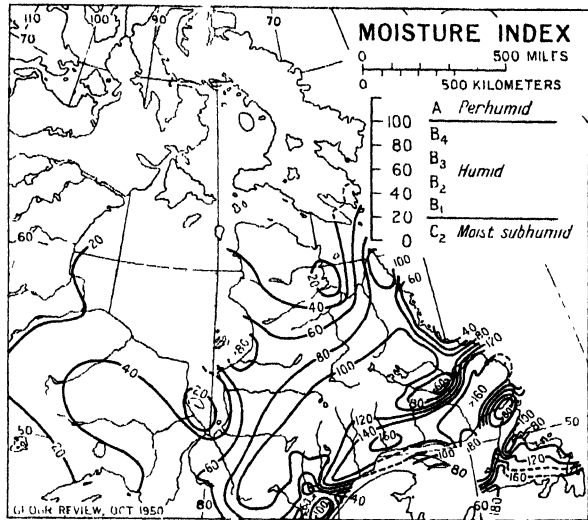


FIG. 12—Moisture index, according to Thornthwaite's classification of 1948. Note high values typical of southern Labrador-Ungava, low values along western margin.

CORRELATIONS BETWEEN CLIMATE AND THE ZONAL FOREST DIVISIONS

It now remains only to establish the relation between the climate distributions and the zonal divisions of the forest. Such attempts were previously made by Halliday²¹ and Villeneuve²² for various parts of the region, but in both cases before data were available from the interior of Labrador-Ungava and before Thornthwaite's new system was published. Villeneuve's maps do not extend beyond the 51st parallel.

Elsewhere, a good deal of work has been done on the growth conditions of the coniferous trees composing the boreal forest climax. With few exceptions, all these investigations have suggested that midsummer temperatures control growth rates and that precipitation is largely ineffective as a control. Thus Hustich reported that the width of annual rings in Scotch pine (*Pinus sylvestris*) at Utsjoki, Lappland, was closely correlated with July mean daily temperature; vertical growth of the trees was likewise

²¹ Halliday, *op. cit.*, pp. 40-45

²² G. O. Villeneuve: Climatic Conditions of the Province of Quebec and Their Relationship to the Forests, *Forest Protection Service Bull. No. 6*, Quebec, 1946.

related to the July temperature of the previous year. Neither vertical nor radial growth was related to variations in summer precipitation.²³ Similar results were obtained by Erlandsson²⁴ and other Scandinavian workers for Scotch pine and other boreal forest conifers. Giddings stressed the dependence of the spruce on summer temperature in both Alaska²⁵ and the Mackenzie Valley.²⁶ The widely accepted view that the northern forests are governed in their growth by temperature, and that precipitation is every-

TABLE II—FOREST DIVISIONS AND POTENTIAL EVAPOTRANSPIRATION IN LABRADOR-UNGAVA

DIVISION	TYPICAL VALUE OF P-E ALONG BOUNDARIES (INCHES)	DOMINANT COVER TYPE
Tundra	12.0-12.5	Tundra
Forest-Tundra Ecotone	14.0-14.5	Tundra and lichen-woodland intermingled
Open Boreal Woodland	16.5-17.0	Lichen-woodland
Main Boreal Forest	18.5-19.0	Close-forest with spruce-fir associations
Boreal-Mixed Forest Ecotone	20.0	Close-forest with white and red pine, yellow birch, and other non-boreal invaders
Great Lakes-St. Lawrence Mixed Forest		Mixed forest

where adequate to supply the needs of the growth possible under such cool conditions, was also accepted by Thornthwaite in his earlier climatic classification.²⁷

The present investigation amply confirms this view. A comparison of Figures 11 and 12 with Figure 4 shows at once that there is an obvious correlation between the zonal forest divisions and thermal efficiency (that is, potential evapotranspiration); the interdivisional boundaries tend to follow the isopleths of potential evapotranspiration. On the other hand, there is no obvious correlation between the moisture provinces and the forest divisions. No evidence whatever has been found to suggest any control of the forest structure by the moisture factor, other than the effects of poor drainage in the muskeg. Table II shows how close is the correlation between thermal efficiency and the forest divisions. With trifling exceptions, the

²³ I. Hustich: On the Correlation between Growth and the Recent Climatic Fluctuation, in *Glaciers and Climate* . . . dedicated to Hans W:son Ahlmann, *Geografiska Annaler*, Vol. 31, 1949, pp. 90-105.

²⁴ S. Erlandsson: Data 23, *Dendrochronological Studies*, Uppsala, 1936.

²⁵ J. L. Giddings, Jr.: Dendrochronology in Northern Alaska, *Univ. of Arizona Bull.*, Vol. 12, No. 4, 1941.

²⁶ *Idem*: Mackenzie River Delta Chronology, *Tree-Ring Bull.*, Vol. 13, 1947, pp. 26-29.

²⁷ C. W. Thornthwaite: The Climates of North America According to a New Classification, *Geogr. Rev.*, Vol. 21, 1931, pp. 633-655.

interdivisional boundaries follow closely the isopleths of potential evapotranspiration suggested in Table II.

The Arctic tree line, the southern limit of the tundra, nowhere reaches Thornthwaite's theoretical potential evapotranspiration value of 11.2 inches. Near the mouth of the George River, which affords a good migration route northward, a thin stand of black spruce and tamarack reaches the value 11.5 inches, but elsewhere the tree line lies between 12 and 12.5 inches. Marr has shown, however, that white spruce is actively invading the tundra near the Great Whale River, and it may well be that there has not been time since the Wisconsin glaciation for the forest to attain its climax tree line.²⁸

Near Richmond Gulf on the Hudson Bay coast and south of Hebron on the Atlantic coast, well-developed black and white spruce groves stand well north of the isotherm of 10° C. (50° F.) for the warmest month.

The narrow strip of coastal tundra fringing the Atlantic coast of Labrador as far south as Belle Isle was formerly thought to be the reflection of the chilling effect of the Labrador Current and its pack ice. Climatological stations directly on this coastal tree line, however, show that the thermal efficiency is adequate to support lichen-woodland (Hopedale, 15.3 inches; Cartwright, 15.3 inches; Belle Isle, 14.5 inches). Evidently temperature is not alone responsible for the lack of trees.

The open boreal woodland extends between the potential evapotranspiration values of 14.0-14.5 and 16.5-17.0 inches. Its southern limit coincides with Thornthwaite's suggested divide between warmer and cooler microthermal climates (C'_1/C'_2). In other words, the forest-tundra ecotone and open boreal woodland correspond with the cool microthermal province.

Wide variations in moisture index occur within this division, without any apparent effect on the vegetation. Since moisture is abundant everywhere, it is of interest to speculate as to the origins of the curious structure of the dominant lichen-woodland, with its widely spaced but fully developed trees and its lichen floor that requires little moisture. Farther south lichen-woodland is definitely a drought type, confined to sandy or gravelly soils.

It may well be that the widespread character of this dry type in the open boreal woodland results from physiological drought, as Schimper has called it. Where frost in the soil is still unthawed in July, the season of peak growth, the trees can derive moisture only from the topmost layers of the soil and hence are driven to assume a horizontally developed root system. Competition between neighboring trees must then mean that the space between individuals has to be greater.

²⁸ Marr, *op. cit*

The main boreal forest occupies the range of potential evapotranspiration between 16.5–17.0 and 20.0 inches. It is invaded by indicators of the Great Lakes–St. Lawrence formation as far north as the 18.5- and 19.0-inch isopleths. The southern limit, 20.0 inches, is faithfully followed from Lake Superior to Gaspé; the 20.0-inch isopleth even curves around the Lake St. John lowland, with the little enclave of mixed forest mentioned above. It is to be noted that Thornthwaite's microthermal-mesothermal boundary (C_2'/B_1') is 22.4 inches; the main boreal forest and the Great Lakes–St. Lawrence formation thus meet in the middle of the warm microthermal province.

The small outlier of warm microthermal climate in the Lake Melville–Hamilton River region coincides reasonably well with the detached area of main boreal forest in the same districts. Though poor in species, the well-developed close-forests of this region offer one of the largest untapped reserves of pulpwood in eastern North America. The region has a thermal efficiency similar to that of the forests now being cut near Clarke City and on Anticosti Island.

THE REMAINING AREAS

Although the delimitation of zonal divisions has not yet been undertaken beyond Labrador–Ungava, a few comments may be made concerning other parts of eastern Canada.

“Native Trees of Canada” includes a revised version of the Halliday map of Canadian vegetation. It distinguishes between a “northern transition” zone and the main boreal forest; and in Labrador–Ungava the line very nearly coincides with the boundary between the open boreal woodland and the main boreal forest. From the vicinity of James Bay west to Manitoba the boundary continues to lie between the 16.5- and 17.0-inch isopleths of potential evapotranspiration. The regions farther north in the Hudson Bay lowland are too little known to permit further correlation.

The islands of Newfoundland and Anticosti lie wholly within the range of potential evapotranspiration found in the main boreal forest, with the solitary exception of the Long Peninsula of Newfoundland. Both islands are largely covered by close-forest, with the spruces and balsam fir as the dominants. There seems no doubt that they lie within the main boreal forest division. The warmest area of Newfoundland (potential evapotranspiration 19–20 inches) lies along the railway line from St. George Bay to the Avalon Peninsula. This thermal efficiency corresponds with the boreal-mixed forest ecotone on the mainland, and it is interesting to note that many non-boreal trees occur in isolated localities (for example, white pine and red maple, *Acer rubrum*). The south coast of Newfoundland is chilled by the onshore

prevailing winds crossing the offshoot of the Labrador Current that moves westward along the coast. Much of the high ground of the south is covered by treeless moss barrens. In many cases the lack of trees is an effect of altitude, but moss barrens occur also at low altitudes in regions where the thermal efficiency is ample to support high forest. Their origin has not been explained.

A preliminary glance at the Russian taiga has shown that zonal divisions comparable with those defined above for Labrador-Ungava have almost identical relationships with climate. This encourages the hope that it will ultimately be possible to extend the present review to the entire extent of the boreal forest formation. It will be of particular interest to see whether anything of the same zonal structure is revealed in the boreal forest of western Canada, where Sanderson has reported the retarding effects of drought. It may well be that the dependence of growth on thermal efficiency so strikingly confirmed in the humid east breaks down in the drier west.

APPENDIX—LIST OF CLIMATOLOGICAL STATIONS

The following list includes all stations to whose detailed records access was obtained. In certain areas beyond the southern margin of the subarctic the high station density has made it necessary to omit some points from the maps and appendix. Within the region itself the list is effectively complete. The dates given do not necessarily indicate the complete period of record: they show only the years used by the author in the statistical analysis. It was sometimes necessary to reject records of certain months or years because they were vitiated, or because of changes in observational practice or large gaps in daily sequences. "B" indicates a broken record. The international index numbers of telegraphic reporting stations are taken from the Department of Transport's *Circular 1521*, January 1, 1949.

STATION	INDEX	LATITUDE	LONGITUDE	ELEVATION	PERIOD
	NO.	N.	W.	(feet)	
Albanel, Que.	—	48°53'	72°27'	635	1922-48
Amos, Que.	—	48°36'	78°07'	1002	1913-48
Anticosti, East Point, Que.	—	49°12'	61°40'	—	—
Arctic Bay, N.W.T.	918	73°16'	84°17'	36	1937-48
Armstrong, Ont.	841	50°18'	88°55'	1065	1925-48
Arvida, Que.	—	48°28'	71°10'	335	1931-48
Ashuanipi, Lab.	817	52°32'	66°14'	1790	1948
Bagotville, Que.	727	48°20'	71°00'	536	1943-48
Baie Comeau, Que.	720	49°12'	68°16'	177	1939-48B
Belle Isle, Nfld.	809	51°53'	55°22'	426	1874-1948
Bersimis, Que.	—	48°55'	68°37'	—	1923-48
Bonavista, Nfld.	—	48°38'	53°05'	—	1934-38B
Botwood, Nfld.	808	49°09'	55°21'	31	1938-48B
Buchans, Nfld.	804	48°51'	56°50'	894	1934-48
Cambridge Bay, N.W.T.	925	69°07'	105°01'	45	1929-48B
Cape Harrison, Lab.	181	54°44'	58°19'	65	1943-48
Cape Hopes Advance, Que.	900	61°03'	69°36'	240	1929-48B

STATION	INDEX NO.	LATITUDE N.	LONGITUDE W.	ELEVATION (feet)	PERIOD
Cape Race, Nfld.	800	46°39'	52°04'	99	1920-48
Cartwright, Lab.	818	53°42'	57°00'	34	1935-48
Channel, Nfld.	—	47°37'	59°09'	50	1893-1918B
Chesterfield Inlet, N.W.T.	916	63°20'	90°43'	13	1921-48
Chibougamau, Que.	821	49°54'	74°18'	1234	1937-48
Chicourimi, Que.	—	48°25'	71°05'	150	1893-1948B
Churchill, Man.	913	58°47'	94°11'	44	1908-48
Chute à Murdock, Que.	—	48°31'	71°15'	300	1921-48
Chute aux Galets, Que.	—	48°39'	71°12'	500	1920-48
Clarke City, Que.	812	50°12'	68°38'	186	1906-47
Clyde River, N.W.T.	090	70°25'	68°17'	10	1942-46B
Colinet, Nfld.	—	—	—	—	1938-48B
Coral Harbour, N.W.T.	915	64°11'	83°17'	193	1943-48
Corner Brook, Nfld.	—	48°57'	57°57'	40	1933-48
Daniels Harbour, Nfld.	185	50°14'	57°35'	49	1946-48
Deer Lake, Nfld.	—	49°06'	57°29'	185	1933-48
Doucet, Que.	—	48°13'	76°37'	1236	1922-39
Ellis Bay, Que.	—	49°50'	64°25'	28	1936-45B
Fogo, Nfld.	806	49°43'	54°17'	25	1910-48B
Fort Chimo, Que.	906	58°05'	68°25'	112	1919-48B
Fort George, Que.	—	53°50'	79°05'	—	1915-44B
Fort McKenzie, Que.	901	56°53'	68°25'	250	1938-48
Fort Ross, N.W.T.	919	72°02'	94°03'	50	1938-47B
Frobisher Bay, N.W.T.	909	63°44'	68°33'	54	1942-48
Gander, Nfld.	803	48°57'	54°34'	482	1937-48
Gillam, Man.	912	56°21'	94°46'	454	1942-48
Glenwood, Nfld.	—	48°59'	54°52'	93	1936-48
Gods Lake, Man.	—	54°40'	94°10'	585	1938-44
Goose Bay, Lab.	816	53°20'	60°24'	144	1941-48
Gouin Dam, Que.	—	48°23'	74°00'	1325	1915-48
Grand Bank, Nfld.	802	47°06'	55°46'	19	1934-48
Grand Falls, Nfld.	—	48°55'	55°40'	200	1913-48B
Great Whale River, Que.	905	55°17'	77°46'	50	1925-48B
Haileybury, Ont.	—	47°27'	79°38'	707	1902-48
Harrington Harbour, Que.	814	50°34'	59°30'	25	1912-48
Hebron, Lab.	—	58°12'	62°37'	49	1883-1910
Hopedale, Lab.	—	55°27'	66°14'	35	1867-1902B
(Moravian Record)					
Hopedale, Lab.	900	55°27'	66°14'	35	1942-46
Howley, Nfld.	—	49°11'	57°06'	384	1934-48B
Ile Maligne, Que.	—	48°40'	71°45'	390	1924-38
Indian House Lake, Que.	098	56°02'	64°44'	1044	1944-48
Kapusking, Ont.	831	49°25'	82°28'	752	1920-48
Kenora, Ont.	850	49°48'	94°22'	1345	1898-1948
Knob Lake, Que.	828	54°50'	66°42'	1550	1948
Lake Edward, Que.	—	47°39'	72°16'	1195	1910-23B
Lake Harbour, N.W.T.	095	62°50'	69°55'	54	1884-1938B
Lake Manuan, Que.	820	50°38'	70°32'	1625	1942-48
Lake Norman, Que.	817	52°08'	63°49'	1625	1942-45
Lake Onatchiway, Que.	—	49°00'	71°02'	1050	1920-48
Lansdowne House, Ont.	846	52°14'	88°00'	840	1938-48

STATION	INDEX NO.	LATITUDE N.	LONGITUDE W.	ELEVATION (feet)	PERIOD
Millertown, Nfld.	—	49°00'	56°21'	692	1934-48
Mingan, Que.	188	50°17'	64°09'	76	1943-48
Mistassini Post, Que.	—	50°30'	73°55'	1235	1915-48
Moose Factory, Ont.	—	51°16'	80°40'	20	1891-1937
Moosonee, Ont.	836	51°16'	80°39'	34	1933-48
Morhiban, Que.	182	51°50'	62°53'	1720	1943-48
Nain, Lab.	—	56°33'	61°40'	13	1883-1902
Nakina, Ont.	840	50°11'	86°42'	1065	1938-47
Natashquan, Que.	813	50°12'	61°49'	18	1914-48
Nitchequon, Que.	826	53°12'	70°35'	1690	1942-48
Nottingham Is., N.W.T.	908	63°07'	77°56'	54	1928-48
Okak, Lab.	—	57°34'	62°03'	16	1876-89B
Padloping Is., N.W.T.	911	67°06'	62°21'	130	1941-48
Pagwa, Ont.	833	50°02'	85°16'	620	1923-48
Pangnirtung, N.W.T.	—	66°09'	65°30'	50	1925-47B
Parent, Que.	726	47°55'	74°37'	1405	1943-48
Pickle Lake, Ont.	845	51°28'	90°18'	1245	1930-48
Pond Inlet, N.W.T.	—	72°43'	78°30'	13	1921-48B
Port Burwell, Que.	—	60°25'	64°46'	—	1928-34B
Port Harrison, Que.	907	58°25'	78°08'	20	1921-48
Port Nelson, Man.	—	57°10'	92°30'	25	1903-14
Ramah, Lab.	—	58°23'	62°21'	10	1872-89
Ramea-Burgeo, Nfld.	—	47°32'	57°31'	—	1934-48B
Red Lake, Ont.	854	51°03'	93°50'	1250	1938-47
Resolution Is., N.W.T.	903	61°18'	64°53'	127	1928-48
Roberval, Que.	—	48°31'	72°13'	532	1913-26
St. Andrews, Nfld.	197	47°46'	59°20'	35	1944-48
St. Anthony, Nfld.	819	51°25'	55°30'	45	1944-48B
St. Félicien, Que.	729	48°39'	72°27'	366	1938-48
St. Georges, Nfld.	—	48°28'	58°25'	10	1902-45B
St. Johns, Nfld.	—	47°34'	52°42'	125	1875-1948
Sandgirt Lake, Lab.	827	53°50'	65°30'	1435	1942-47
San Maur, Que.	—	47°53'	73°48'	1170	1930-48
Senneterre, Que.	728	48°24'	77°15'	1038	1940-48
Seven Islands, Que.	811	50°13'	66°16'	190	1943-48
Sioux Lookout, Ont.	842	50°07'	91°54'	1227	1915-48
Southwest Point, Que.	810	49°24'	63°33'	24	1881-1948
Stephenville, Nfld.	815	48°32'	58°33'	44	1943-48
Tadoussac, Que.	—	48°10'	69°40'	25	1913-48
Torbay, Nfld.	801	47°37'	52°44'	463	1942-48
Trout Lake, Ont.	848	53°50'	89°52'	720	1938-48
Zoar, Lab.	—	56°07'	61°22'	33	1883-1902B

MEASURING POTENTIAL EVAPOTRANSPIRATION AT NORMAN WELLS, 1949*

MARIE SANDERSON

ONE of the most important but least-known elements of climate is potential evapotranspiration, or water need, defined by C. W. Thornthwaite, director of The Johns Hopkins Laboratory of Climatology, as "the amount of moisture that would be transferred from a vegetation-covered soil to the atmosphere by evaporation and transpiration if it were constantly available in optimum quantity."¹ If the potential evapotranspiration is compared with the water supply, fluctuations in soil moisture can be estimated and subsequent periods of water surplus and deficiency determined.

There is very little information on the geographic distribution of potential evapotranspiration, since, unlike actual evapotranspiration or water loss, it cannot be measured directly but must be determined experimentally. The importance of knowing the seasonal march of water need and its distribution over the surface of the earth led Thornthwaite to use all existing experimental data, chiefly from irrigation experiments in the western United States, to discover a relationship between potential evapotranspiration and climatic factors about which there is abundant information. The result was a rather complex formula for computing the daily or monthly water need from the mean air temperature, with a modifying length-of-day factor. The method was used by Thornthwaite to describe the climatic regions of the United States² and by the present author to divide Canada into climatic regions.³

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¹ H. G. Wilm, C. W. Thornthwaite, and others: Report of the Committee on Evaporation and Transpiration 1945-46, *Trans. Amer. Geophys. Union*, Vol. 27, 1946, pp. 721-723.

² C. W. Thornthwaite: An Approach Toward a Rational Classification of Climate, *Geogr. Rev.*, Vol. 38, 1948, pp. 55-94.

³ Marie Sanderson: The Climates of Canada According to the New Thornthwaite Classification, *Scientific Agriculture*, Vol. 28, 1948, pp. 501-517.

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As a means of verifying the formula, Thornthwaite has devised an instrument to measure the daily water need, and "evapotranspirometers" have been put into operation at Seabrook, N. J.,⁴ near Mexico City,⁵ and at Toronto and Kapuskasing, Ont.⁶ Figures of potential evapotranspiration, obtained during several years of observation, indicate that the formula provides values of water need of the right order of magnitude for these latitudes. Since the formula was developed from mid-latitude data, it was felt that results obtained by extrapolation poleward or equatorward might be uncertain, but recent evidence from the Belgian Congo of similarity between computed and measured potential evapotranspiration lends support to the formula for low latitudes.⁷

When applied to climatic data for high latitudes in northwestern Canada, the formula indicated high water needs in summer, and this result, coupled with the fact that the precipitation is known to be low, led to a dry sub-humid climatic classification for the region. Although this conclusion has been questioned, data on vegetation, soils, crop production, and stream flow support the evidence of summer drought in the Northwest.⁸ The establishment of an evapotranspirometer station in northern Canada was obviously the way to determine the validity of poleward extrapolation of the Thornthwaite formula, and it would also provide valuable daily figures of potential evapotranspiration in a sub-Arctic region. Furthermore, verification of the formula here would lend support to a recent study in which Thornthwaite applied his method of analyzing climatic data to determine periods of surplus and deficiency in predicting the ground conditions that might be expected in every month of the year in the Arctic regions.⁹

EVAPOTRANSPIROMETER EQUIPMENT

A diagrammatic sketch of the equipment used in the Northwest Territories is shown in Figure 1. In principle it is the same as that used in the Toronto experiment, which has been described in detail in an earlier pub-

⁴ *The Johns Hopkins Univ. Laboratory of Climatology Interim Repts.*, No. 4, 1948; No. 5, 1949; and No. 7, 1949.

⁵ A. Contreras Arias: La medida de la evapotranspiración, como base para la solución de problemas agrícolas importantes, *Chapingo*, No. 21, May, 1948, pp. 16-22.

⁶ Marie Sanderson: An Experiment to Measure Potential Evapotranspiration, *Canadian Journ. of Research*, Sect. C, Vol. 26, 1948, pp. 445-454.

⁷ See Étienne Bernard: Le climat écologique de la Cuvette centrale congolaise, *Publ. Inst. Natl. pour l'Étude Agronomique du Congo Belge*, Brussels, 1945, pp. 182-189, and the review by the present writer in *Ecology*, Vol. 30, 1949, pp. 265-269.

⁸ Marie Sanderson: Drought in the Canadian Northwest, *Geogr. Rev.*, Vol. 38, 1948, pp. 289-299.

⁹ C. W. Thornthwaite: Climatic Analysis of Soil Tractionability, Office of the Quartermaster General, Environmental Protection Section. (In press.)

lication.¹⁰ The grass-covered surface of the tank, with approximately natural microclimatic conditions, is kept constantly moist by subirrigation, and the daily water use is measured. It is assumed that the plants will use all the water they require and that evaporation and transpiration will depend solely on atmospheric conditions.

The modified intake tank, D, has an inside area one-fiftieth of the area of the evaporating tank, A, so that computation of the daily water loss is

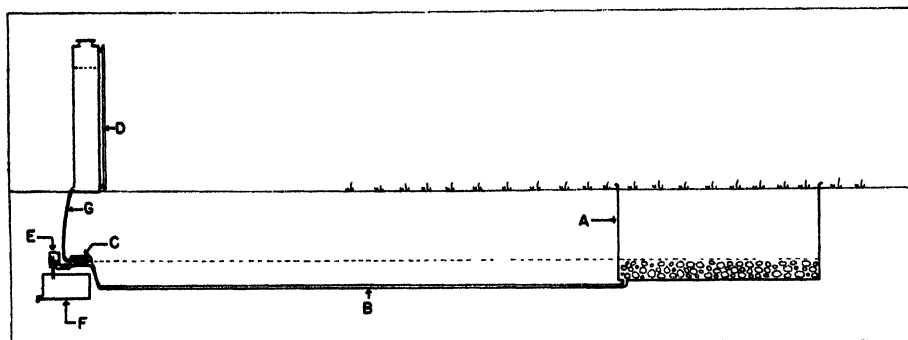


FIG. 1.—Diagrammatic sketch of evapotranspirometer equipment used. Key: A, evaporating tank; B, underground irrigation pipe; C, carburetor float valve; D, intake tank with glass gauge; E, overflow mechanism; F, overflow tank; G, connecting rubber tubing.

simple; for example, a drop of 10 millimeters in D means a loss of 0.2 millimeters from the surface of A. Water entering the soil of the evapotranspirometer tank comes from the intake tank and from precipitation. Water can leave the tank only by overflowing into the overflow tank, F, or by upward transfer into the air as water vapor—the potential evapotranspiration. That is,

$$E = P + I - O,$$

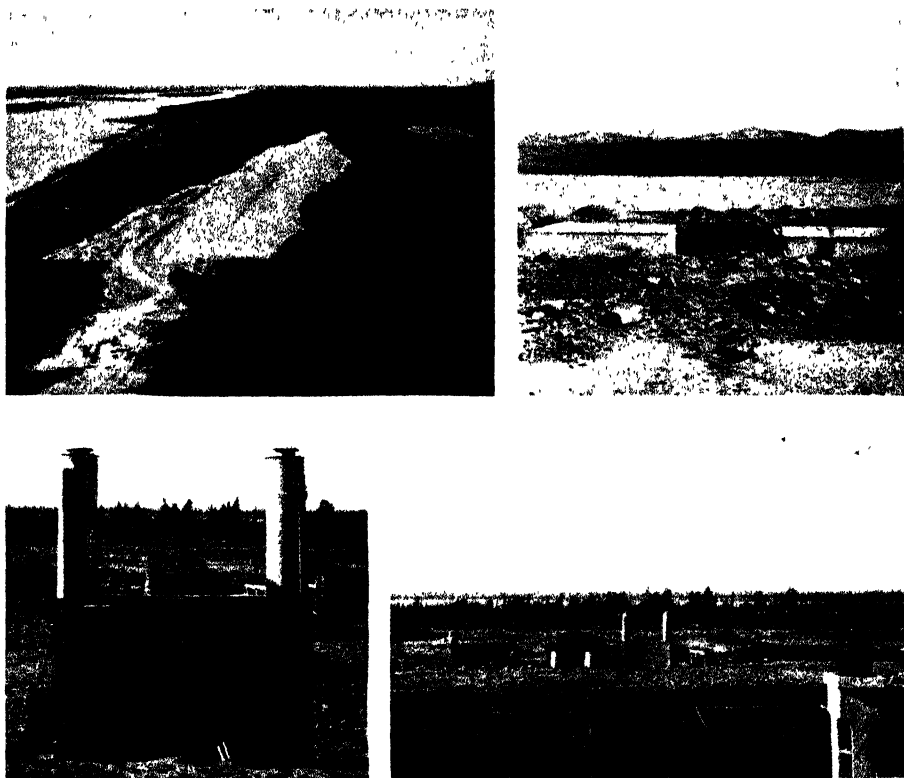
where E is potential evapotranspiration, P is precipitation, I is intake, and O is overflow.

CHOICE OF LOCATION

In the Thornthwaite formula the length-of-day correction factor for latitude 50° N. is used empirically for all stations farther north. To confirm the validity of this usage, it was desirable to install the apparatus in a region with the greatest possible number of hours of daylight, provided the chosen site had the necessary three feet of unfrozen soil in summer. Specialists in permafrost stated that a location in the Mackenzie Valley would be most suitable, since summer temperatures there are considerably higher, and the permafrost danger less, than at the same latitudes in eastern Canada. Norman

¹⁰ Sanderson, *An Experiment to Measure Potential Evapotranspiration* (*op. cit.*).

Wells, $64^{\circ} 50' \text{ N.}$, $125^{\circ} 20' \text{ W.}$, was chosen in agreement with personnel of the Meteorological Division of the Department of Transport, who have cooperated in the project from the beginning. Norman Wells has a well staffed synoptic weather station, and its meteorological officer agreed to undertake the responsibility of the experiment. In addition, Norman Wells



FIGS. 2 5—Site and equipment of the experiment; explanation in text

has the northernmost airport where commercial planes capable of carrying the necessary equipment could land.

SITE AND INSTALLATION

The apparatus was installed at the airport, where it was easily accessible from the meteorological offices, rather than in the town of Norman Wells, about three miles distant. Figure 2 is an aerial view of the airport, with the approximate location of the experiment at X; the town itself appears in the left background. A break in slope of about five feet made it possible to install the overflow equipment above ground and thus avoid permafrost. Figure 3 shows the tanks during installation, and Figure 5 the equipment in opera-

tion. Topsoil from a neighboring locality was used both in the tanks and as dressing for the surrounding area (about 25 feet square) and was fertilized and sown with Kentucky bluegrass, recommended by the Dominion Department of Agriculture because of its resistance to winter killing. The transpirometer (evaporation) tanks are in the foreground of Figure 5, with the grass planted but not yet visible. The intake tanks and the shelter housing

TABLE I—MEAN TEMPERATURES, NORMAN WELLS, JULY, 1949

Column I: Mean as average of 24 hourly readings

Column II: Mean as average of maximum and minimum

July	I	II	July	I	II
2	53.7	53.0	17	58.0	56.6
3	61.2	60.8	18	66.0	66.1
4	63.6	64.6	19	68.2	68.8
5	49.5	51.6	20	66.4	64.2
6	49.3	49.8	21	64.4	59.8
7	58.6	57.6	22	62.1	67.2
8	63.4	58.8	23	57.9	57.2
9	68.7	66.6	24	63.1	63.6
10	69.8	70.0	25	53.9	54.6
11	74.8	74.5	26	51.1	47.6
12	74.2	73.7	27	59.8	60.5
13	72.7	73.6	28	64.4	61.2
14	58.9	59.3	29	61.1	61.3
15	54.8	54.0	30	66.4	65.8
16	53.2	53.6			

the carburetors and overflow tanks are in the center, and the Mackenzie River in the background. Figure 4 is a close-up of the shelter and intake tanks showing the graduated glass gauges.

READINGS AND OBSERVATIONS

Installation of the two tanks was completed on June 29, the grass was planted on June 30, and readings began July 2. The readings, taken at 9:30 a. m. Pacific standard time, comprised the following: (1) the height of water on the intake gauge, in millimeters; (2) the water in the overflow tank, if any, in cubic centimeters (a table converts the reading to millimeters of water loss from tank); (3) the precipitation and the maximum and minimum temperatures for the preceding 24 hours.

For computing the water loss by the Thornthwaite formula the mean temperature is required. To determine whether the mean temperature obtained by averaging the maximum and minimum temperatures was a true mean, a comparison was made with the average of the 24 hourly temperature readings during July (Table I). Few major discrepancies were found, and the total water loss computed from the hourly figures was only three millimeters greater than that obtained by the simpler method.

The daily readings for the period July 2 to September 1 are given in

Table II. During the early part of the season, before the grass provided cover for the soil and kept it moist, water was added to the surface of the tanks to obtain a more accurate measure of the potential evaporation, since the surface of bare soil dries out and reduces evaporation. The amounts of water added in this way are indicated by asterisks in the precipitation (P) column. The surrounding area was also kept watered to provide a homogeneous microclimate and ensure the germination of the grass.

Some daily values of potential evapotranspiration in July were extremely high. On July 11 the measured water loss (potential evapotranspiration) from the two tanks averaged 8.7 millimeters; the highest measured daily water loss from the Toronto transpirometers in July was 7.2 millimeters. On July 11, 12, and 13, the warmest days of the season at Norman Wells, the losses were all more than 7 millimeters. It is interesting to note that the total measured potential evapotranspiration from the Norman Wells transpirometers for July was exactly the same as from the Toronto transpirometers, though the mean monthly temperature at Norman Wells was only 60.6° F., whereas at Toronto it was 73.8° F. For August, the measured loss at Norman Wells was 87 millimeters and at Toronto 132 millimeters; the mean monthly temperatures were 58.9° F. and 72.8° F. respectively.

The accumulated water losses, measured and computed from the Thornthwaite formula, are shown graphically in Figure 6. Figure 7 shows, for comparison, the maximum, minimum, and mean temperatures and precipitation. Although daily readings of water loss from the two tanks often differed, the totals for the period indicated an instrumental variation of only two millimeters (A, 234 millimeters; B, 232 millimeters). The total measured water loss was also almost exactly the same as the computed total. During July, which had only 3.91 millimeters (1.54 inches) of rain, total measured potential evapotranspiration was much higher than computed: 141 and 145 millimeters, as compared with 121 millimeters. August was an abnormal month for Norman Wells, with a record-breaking precipitation of 11.63 millimeters (4.58 inches), but the total measured water losses were 90 and 84 millimeters, lower than the computed total (107 millimeters). Whether the higher humidity during August was the only cause of the lower evapotranspiration has not yet been determined. Perhaps the record of another season will furnish some explanation.

The grass in the tanks and in the surrounding area was kept as far as possible at a uniform height throughout the season to ensure similar microclimatic conditions. Dates of cutting and the air-dry weights of the grass from the tanks are as follows: August 5, Tank A 22 grams, Tank B 75

TABLE II--EVAPOTRANSPIROMETER READINGS (TANKS A AND B), NORMAN WELLS, 1949

(Water loss and overflow in millimeters over surface of tank)												
DATE	TEMPERATURE			PRECIPITATION		OVERFLOW		INTAKE		EVAPOTRANSPIRATION*		
	Max.	Min.	Mean	In.	Mm.	A	B	A	B	A	B	Com- puted
July												
2	58.8	47.3	53.0	0	2.16*	0.28	0.43	0.24	0	2.12	1.73	2.95
3	70.6	50.9	60.8	0.13	3.30	0	0.30	0	0.04	3.30	3.04	4.15
4	74.9	54.2	64.6	0.05	1.27 3.02*	0.40	0.49	0.36	0.36	5.42 4.25	4.77 4.16	7.10 4.56
5	62.4	40.7	51.6	0.33	8.38 3.02*	0	2.80	0	0	9.67 11.40	8.93 8.60	11.66 2.81
6	59.5	40.1	49.8	0.12	3.05	0.95	1.01	0.02	0.04	21.07 2.12	17.53 2.08	14.47 2.55
7	68.2	47.1	57.6	0		0.41	0.06	0.02	0.74	23.19 -0.39	19.61 0.68	17.02 3.62
8	74.2	43.4	58.8	0.03	0.76 3.02*	0.02	0.09	0.40	0.72	22.80 4.16	20.29 4.41	20.64 3.89
9	81.5	51.8	66.6	0	3.02*			1.32	1.74	26.96 4.34	24.70 4.76	24.53 4.82
10	85.0	54.9	70.0	0	3.02*			2.58	2.86	31.30 5.60	29.46 5.88	29.35 5.36
11	86.8	62.2	74.5	0.02	0.51 6.69*			1.70	1.28	36.90 8.90	35.34 8.48	34.71 5.59
12	86.4	61.0	73.7	0	6.04*			1.26	0.88	45.80 7.30	43.82 6.92	40.30 5.59
13	89.2	58.0	73.6	0	6.04*			1.18	1.02	53.10 7.22	50.74 7.06	45.89 5.59
14	67.3	51.3	59.3	0.41	10.41 3.02*	3.53	5.48	0.76	0.08	60.32 10.66	57.80 8.03	51.48 3.86
15	58.9	49.0	54.0	0		1.51	1.04	0.02	0	70.08 -1.49	65.83 -1.04	55.34 3.17
16	58.2	49.0	53.6	0		0.04	0	0	0.44	60.49 -0.04	64.79 0.44	58.51 3.04
17	66.1	47.0	56.6	0		0.04	0.09	0.22	2.16	69.45 0.18	65.23 2.07	61.55 3.43
18	72.8	59.4	66.1	0	4.54*	0	0	1.54	2.02	69.63 6.08	67.30 6.56	64.98 4.75
19	76.7	60.8	68.8	0	6.04* (B only)	0	0	3.08	2.18	75.71 3.08	73.86 8.22	69.73 5.11
20	76.7	51.6	64.2	0	6.04*	0	0	1.58	1.52	78.79 7.62	82.08 7.56	74.84 4.45
21	75.0	44.7	59.8	0	4.54*			0.34	0.62	86.41 4.88	89.64 5.16	79.29 3.93
22	72.4	41.9	57.2	0	4.54*			1.72	1.64	91.29 6.26	94.80 6.18	83.22 3.51
23	71.2	43.1	57.2	0	3.02*			2.18	2.36	97.55 5.20	100.98 5.38	86.73 3.51
24	71.2	56.0	63.6	0	3.02*			1.34	1.22	102.75 4.36	106.36 4.24	90.24 4.26
25	61.7	47.4	54.6	0	3.02*			1.04	1.14	107.11 4.06	110.60 4.16	94.50 3.10
26	58.1	37.0	47.6	0	1.51*			1.68	1.90	111.17 3.19	114.76 3.41	97.60 2.18
27	67.2	53.9	60.6	0	3.02*			1.18	1.20	114.36 4.20	118.17 4.22	99.78 3.84
28	76.1	46.2	61.2	0	3.02*			1.48	1.00	118.56 4.50	122.39 4.02	103.62 3.97
29	75.8	46.8	61.3	0.10	2.54			1.06	1.30	123.06 3.60	126.41 3.84	107.59 3.97
30	78.3	53.2	65.8	0	3.02*			1.64	2.26	126.66 4.66	130.25 5.28	111.56 4.57
31	77.8	55.0	66.4	0.35	8.89	0	0.04	0.32	0.82	131.32 9.21	135.53 9.67	116.13 4.57
										140.53	145.20	120.70

*Daily and (in italics) accumulated.

*Surface addition to both tanks.

**Surface addition to Tank A only.

TABLE II—Continued

DATE	TEMPERATURE			PRECIPITATION		OVERFLOW		INTAKE		EVAPOTRANSPIRATION ^a		
	Max.	Min.	Mean	In.	Mm.	A	B	A	B	A	B	Computed
Aug.												
1	68 9	54 6	61.8	0.06	1 52			0 82	1 34	2 34	2 86	4 06
										142 87	148 06	124 76
2	70 0	50 2	60 1	0	1 51*			0 86	0 14	2 37	1 65	3 81
										145 24	149 71	128 57
3	72 0	47 0	59 5	0	1 51*			0 84	0	2 35	1 51	3 65
										147 59	151 22	132 22
4	74 3	54 2	64 2	0	1 51*			6 26	6 18	7 77	7 69	4 28
										155 36	158 91	136 50
5	74 2	51 9	63 0	0	1 51**			2 30	2 56	3 81	2 56	4 16
										159 17	161 47	140 66
6	70.8	49 0	59 9	0 01	0 25			1 42	2 92	3 18	3 17	3 75
					1 51**					162 35	164 64	144 41
7	73 0	58 0	65 5	0	1 51**			1 68	2 46	3 19	2 46	4 37
										165 54	167 10	148 78
8	67 2	54 6	60 9	0 75	19 05	1 04	1 64	1 78	1 48	19 79	18 89	3 84
										185 33	185 99	152 62
9	65 8	49 8	57 8	0 02	0 51	5 01	6 00	0 02	0 06	4 48	5 43	3 47
										180 85	180 56	156 09
10	65 3	50 7	58 0	0		2 93	1 04	1 70	0 24	1 23	0 80	3 44
										179 62	179 76	159 53
11	71 3	49 1	60 2	0		0 34	0 09	0 62	0 52	0 28	0 43	3 69
										179 90	180 19	163 22
12	78 1	54 2	66 2	0 03	0 76			2 08	2 86	2 84	3 62	4 39
										182 74	183 81	167 61
13	73 2	51 0	62 1	1 09	27 69	13 52	16 49	0 44	1 36	14 61	12 56	3 87
										197 35	196 37	171 48
14	52 2	47 2	49 7	1 04	26 42	18 48	16 80	0 22	0	8 16	9 62	2 30
										205 51	205 90	173 78
15	50 2	47 5	48 8	0 77	19 56	17 84	18 88	0	0	1 72	0 68	2 16
										207 23	206 67	175 94
16	51 4	47 4	49 4	0 11	2 79	11 23	9 55	0	0	8 44	6 76	2 28
										198 79	199 01	178 22
17	54 7	48 1	51 4	0 11	2 79	4 36	4 88	0 22	0 28	1 35	1 81	2 50
										197 44	198 10	180 72
18	62 1	48 3	55 2	0 59	14 99	5 01	5 96	0	0	9 98	9 03	2 97
										207 42	207 13	183 69
19	64 0	47 3	55 6	0		5 44	6 00	0	0	5 44	6 00	2 97
										201 98	201 13	186 66
20	70 8	47 2	59 0	0		1 04	0 39	0	0	1 04	0 39	3 42
										200 94	200 74	190 08
21	72 9	53 0	63 0	0		0 04	0	0 04	0 24	0	0 24	3 89
										200 94	200 98	193 97
22	75 4	44 6	60 0	0				1 22	1 48	1 22	1 48	3 51
										202 16	202 46	197 48
23	74 9	51 3	63 1	0				1 78	1 40	1 78	1 40	3 86
										203 94	203 86	201 34
24	73 4	47 2	60 3	0	1 51*			2 70	2 18	4 21	3 69	3 48
										208 15	207 55	204 82
25	60 0	46 2	53 1	0	1.51*			1 30	1 76	2 81	3 27	2 55
										210 96	210 82	207 37
26	73 1	47 6	60 4	0				2 32	0 46	2 32	0 46	3 48
										213 28	211 28	210 85
27	70 2	41.8	56 0	0	3.02*			2 96	5 00	5 98	8 02	2 99
										219 26	219 30	213 84
28	62 8	40.8	51 8	0				2 86	0 98	2 86	0 98	2 41
										222 12	220 28	216 25
29	74.8	49 2	62 0	0				3 26	2 90	3 26	2 90	3 64
										225 38	223 18	219 89
30	82 0	48 8	65 4	0				1 64	2 74	1 64	2 74	3 99
										227 02	225 92	223 88
31	81 2	49 3	65 2	0				3 62	3 24	3 62	3 24	3 95
										230 64	229 16	227 83
Sept.												
1	75.2	54 0	64.6	0				3 58	3 18	3 58	3 18	3 84
										234 22	232 34	231 67

Accumulated Potential Evapotranspiration, Norman Wells, 1949

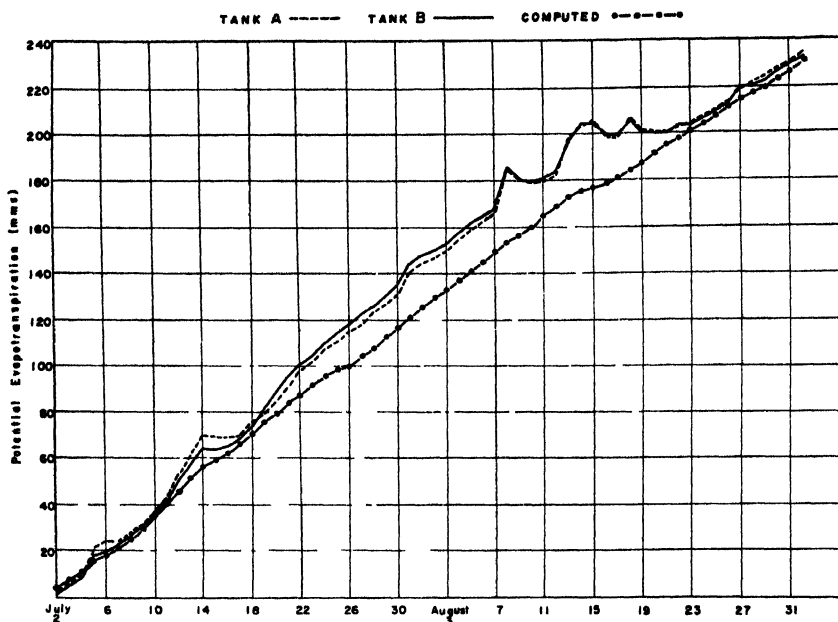


FIG 6

Daily Temperature and Precipitation Norman Wells, July 2 - September 1, 1949

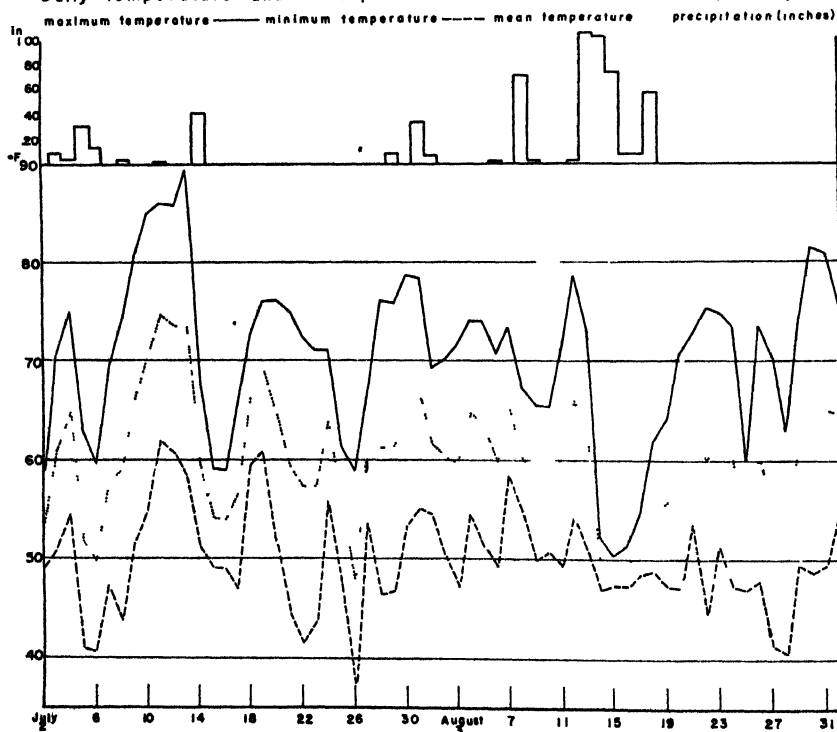


FIG 7

grams; August 11, 164 and 183; August 22, 207 and 201; August 31, 210 and 175; total, Tank A 603 grams, Tank B 634 grams.

The experiment was terminated for the season on September 2 when a cloudburst, bringing 1 inch of rain in 15 minutes, undermined the shelter and disconnected the pipes from the carburetors, allowing the water to drain from the tanks. Since frosts usually occur in this locality by mid-September, the observer decided to delay repairs until spring, when readings were resumed.

EVALUATION OF RESULTS

The first season's results from the two evapotranspirometers at 65° N. seem to indicate that extrapolation poleward in the use of the Thornthwaite formula gives results of the right order of magnitude, in spite of the fact that the length-of-day correction factor for 50° N. latitude is used empirically for all stations farther north. Although the daily measured potential evapotranspiration does not always agree with the computed value, the totals for the season are almost the same.

On the basis of the high observed values of summer water need at Norman Wells and the increasing amount of secondary evidence of summer drought, it would seem advisable that agricultural estimates consider the subhumid nature of the climate as well as the short growing season among the factors limiting agricultural expansion in the Northwest. Certainly the fact that gardens and lawns at Norman Wells have to be extensively irrigated is an indication of the high summer evaporation and drought there.

In the field of soil tractionability the season's results, by verifying the formula for computing potential evapotranspiration at high latitudes, lend support to the conclusions of Thornthwaite's recent study of ground conditions in the Arctic regions.

MAP OF THE WORLD DISTRIBUTION OF POLIOMYELITIS*

JACQUES M. MAY

THE accompanying map (Pl. I) of the world distribution of poliomyelitis is the first of a series of maps that will eventually make up the American Geographical Society's projected "Atlas of Diseases." It has been planned to be a complete and self-contained unit, representing graphically data assembled from the thousand-odd sources listed on the back. In many parts of the world the phenomena of disease are unobserved or unreported, and reported information is often inaccurate; but the map may be said to constitute a census of our present knowledge of the epidemiology of poliomyelitis and future maps of the series will have the same basic purpose. The base consists of six separate maps, each representing a major land mass, arranged so as to show approximate geographical relationships. An azimuthal equal area projection has been used in all cases; the map of Europe is on twice the nominal linear scale of the others. The same base will be used as far as possible throughout the series; where relief is relevant, a relief plate may be added.

To whom will the map of poliomyelitis be of use? Primarily, perhaps, to public health officers, who may not have all the facts readily at hand; to medical practitioners, who may not have time for the extensive reading necessary to acquire the general picture of the epidemiology of the disease; and to teachers and students of epidemiology, who may find in it fruitful subjects for discussion. Indeed, it is hoped that among persons with medical training the map will suggest ideas or hypotheses that may shed light on some of the obscure problems associated with the occurrence of poliomyelitis. Secondly, the map should be of interest to the many who have felt the shadow of the disease and wish to become better informed about it. Geographers will recognize the challenge inherent in the representation of complex medical data in map form—the middle course between oversimplification and illegibility is hard to follow—and will be mainly concerned with the distributional aspects of the map. Whoever makes use of it will find that a vast amount of information is shown, and the patience and care required to read the map will, we trust, be rewarded.

*Aided by a grant from the National Foundation for Infantile Paralysis.

► DR. MAY is head of the Society's Department of Medical Geography. Some aspects of the program being carried on under his direction were described in "Medical Geography: Its Methods and Objectives" in the *Geographical Review* for January, 1950.

The data shown are derived from four principal sources: (1) reports issued by public health agencies throughout the world; (2) the *Epidemiological Bulletin* of the World Health Organization; (3) references listed in the "Bibliography of Infantile Paralysis" published by the National Foundation for Infantile Paralysis; and (4) answers to questionnaires sent out by the American Geographical Society to more than 150 health agencies, both here and abroad.

The map shows two groupings. In the first, data pertaining to regions where poliomyelitis occurs at a rate of fewer than 10 cases per 100,000 inhabitants per year are shown, including the most recent available figures for the number of cases and deaths; in the second, data pertaining to regions where cases occur at a rate of 10 or more per 100,000. As the disease has apparently increased in recent years, it has seemed helpful to classify these data within three periods: 1900-1919; 1920-1939; and 1940-1949. Epidemics occurring within these three periods are differentiated by symbol. It should be remembered, however, that in some areas notification of poliomyelitis has only just begun, and the increase in the number of epidemics recorded within the past few years may be partly explained by a growing interest and the beginnings of investigation. A factor of significance is the morbidity rate, and three values have been distinguished.

Where several epidemics have occurred in each of the three periods, the peak year has been selected; symbols for each period are weighted so that for any given area on the map it is possible to determine whether epidemics have been frequent, when they have occurred, and what the highest morbidity rate has been. In interpreting epidemiological data the dispersion of population is an important factor. For example, in a small village such as Chesterfield Inlet on Hudson Bay, which has 257 inhabitants, 60 cases represents a serious epidemic. If the 257 inhabitants had been widely dispersed, the significant area would have been limited to the few houses where the cases were located. In an effort to show this, certain epidemics known to have occurred within a limited area have been indicated by underlining the year of occurrence and encircling the area.

The age groups most frequently attacked vary from place to place. In Chile, for instance, and in Brazil the age group most frequently attacked seems to be that of less than one year, an indication that the virus is so widespread that contacts are established very early in life; in such areas virtually everyone comes in contact with the virus, and an immunity is built up. In North America the age group most frequently attacked seems to be the 5 to 15-year group, and in isolated areas such as Chesterfield Inlet and the Nic-

obar Islands, where there has been little or no contact with the virus, everyone, irrespective of age, is liable to attack.

Some areas, where people have built up immunity and do not readily develop the disease, are reputed to be free or relatively free from poliomyelitis. But when strangers move into these areas, as happened with military personnel during the war, epidemics occur among the newcomers, while the natives remain unaffected, presumably immune to their own strain of virus. Places where such a situation has existed are shown on the map by a special symbol. In other areas the native population is not completely immune to its own strain of virus, and the local inhabitants are affected as well as foreigners. This is what happened in Malta in 1942; military personnel of all ages developed the disease, along with children under 5 years; older children and adults in the native population showed immunity.

In an effort to discover places where widespread dissemination of the virus exists without outbreaks of epidemics, so-called "neutralization" tests have been devised that demonstrate the presence of antibodies in the serum of the inhabitants. These experiments have been recorded on the map by means of a special symbol. When foreigners move into such regions in large numbers, the outbreak of an epidemic is likely to reveal the existence of a latent endemicity.

GEOGRAPHICAL SERIALS*

CHAUNCY D. HARRIS AND JEROME D. FELLMANN

SOURCES of geographical data are manifold: books, maps, photographs, statistical compilations, government documents, miscellaneous fugitive material, personal contacts, field work (observation, mapping, and interviewing), and periodicals and other serials. This paper is limited to the last-named source, one of the most fruitful of all.

A serial is simply a numbered publication. It may be a periodical published at regular intervals, such as the *Geographical Review*, or a series published irregularly, such as the *Research Series* of the American Geographical Society. This class of publications poses special difficulties and offers particular rewards. Serials are collections, and pertinent material in them can often be located only through bibliographies or special indexes. Yet the most recent advances, and certainly the best general summaries, of work in specific fields or areas are usually contained in periodical articles and reviews, and some of the best monographs are published in series.

Only a small number of the serials utilized by the geographer are primarily geographical. The student of a special topic is likely to use serials in closely related systematic fields—geology or economics, for example. The researcher in a specific area may find a general regional periodical of particular utility. These related materials, however, differ according to the topic or the region, and it is difficult, if not impossible, to tabulate all serials of potential value to geographers. This analysis is therefore limited to geographical serials proper.

Since geographical publications frequently report most comprehensively on regions near at hand, even the obscure serial published in an out-of-the-way place in a strange tongue may be a valuable source of geographical information; thus the geographer is more interested in foreign and minor serials than a scholar in certain other fields would be.

COMPILATION OF A UNION LIST OF GEOGRAPHICAL SERIALS

The authors recently compiled a union list of geographical serials, which contains 1197 titles.¹ Under each entry are given the title, issuing agency, place of publication, volumes published, dates of publication, whether currently published, and changes in title, including predecessors or successors. For example, the entry for the *Geographical Review* indicates that it is published by the American Geographical Society of New York, that it is published in New York, that Volume 1 appeared in 1916, that it is currently published, and that it supersedes the *Bulletin of the American Geographical Society*.

Data are also furnished on library holdings. For each serial the complete holdings of

* The idea of an article on geographical serials was suggested to the authors by some manuscript notes left by the late Elizabeth T. Platt, former Librarian of the American Geographical Society.

¹ Chauncy D. Harris and Jerome D. Fellmann, with the active collaboration of Burton W. Adkinson, Nordis Felland, G. R. Crone, and M. Foncin: *A Union List of Geographical Serials*, 2nd edit., Univ. of Chicago Dept. of Geography Research Paper No. 10, Chicago, 1950.

► DR. HARRIS is professor of geography at the University of Chicago. He has contributed several articles on urban geography to the *Geographical Review* and has long been interested in geographical source materials. DR. FELLMANN is instructor in geography at the University of Illinois. His major interests are urban and transportation geography.

four leading geographical libraries are indicated: the Library of Congress in Washington, the Library of the American Geographical Society in New York, the University of Chicago Library in Chicago, and the Library of the Royal Geographical Society in London. The cities in which these libraries are located are the leading centers of geographical activity in the English-speaking world. In addition, for French serials the complete holdings of the three principal geographical libraries of Paris are indicated: Bibliothèque Nationale, Société de Géographie, and Institut de Géographie of the Université de Paris. For Japanese serials the holdings of the University of Michigan are also indicated. The holdings of other American libraries are listed only to inform where a complete set of a given serial may be consulted. For example, for the *Geographical Review* it is noted that the Library of Congress, the American Geographical Society, the University of Chicago, and the Royal Geographical Society

TABLE I—AREAL DISTRIBUTION OF GEOGRAPHICAL SERIALS

AREA	ALL DATES		1950		AREA	ALL DATES		1950	
	No.	%	No.	%		No.	%	No.	%
Europe (except U.S.S.R.)	677	62.0	189	52.2	Asia	57	5.2	29	8.0
U.S.S.R.	113	10.3	19	5.3	Australia	13	1.2	11	3.0
Anglo-America	94	8.6	37	10.2	International	14	1.2	8	2.2
Latin America	102	9.4	59	16.3					
Africa	22	2.1	10	2.8	Total	1092	100.0	362	100.0

all have complete sets of Volumes 1 to 39 (1916-1949). Since these libraries have complete sets, the holdings of other libraries are not indicated. For the *Publicación* of the Pan American Institute of Geography and History, the holdings of the four key libraries are listed, but since none has a complete set, the holdings of the Columbia University Library are also given, and it is noted that Columbia has the only complete set in the United States.

The serials are arranged by countries, and the countries grouped by continents. Thus one can readily examine as a group the serials published in a country, such as Brazil, or in a larger area, such as Latin America. An alphabetical index including cross references is also provided.

A STATISTICAL SUMMARY OF GEOGRAPHICAL SERIALS

From 1723, when the first periodical bearing the word "geography" made its appearance,² to the middle of the twentieth century 1197 known geographical serials have been published. Sufficient data have been available to permit analysis of the patterns of publication of 1092 of these serials.

Geographical serials have shown sharp localization in place of publication—by continent, country, and city. Among the major divisions, Europe, exclusive of the Soviet Union, leads with 62 per cent of all geographical serials that have ever been published, or nearly three-fourths if the Soviet Union is included (Table I). Of serials currently published (1950) Europe, including the Soviet Union, accounts for 57 per cent, the Americas 27 per cent, and the rest of the world 16 per cent.

Although 63 countries have contributed geographical serials during the past two centuries and a quarter, more than half of these publications have appeared in six leading states:

² Historisch-geographische und genealogische Anmerkungen über verschiedene in denen neuesten Zeitungen des Jahres . . . vorkommende besondere Sachen, Königsberg, Germany, 1723-1725.

Germany, the Soviet Union, France, the United States, Italy, and the United Kingdom (Table II). In number of geographical serials ever published, Germany has attained a commanding leadership. Its output of 254 such serials, 23.3 per cent of all geographical serials, exceeds the combined output of France, the United States, and the United Kingdom. The Soviet Union with 113 serials occupies second place, followed closely by France and the United States; Italy and the United Kingdom follow at some distance. If only current serials are counted, Germany, in spite of severe difficulties, still maintains the lead, followed by the United States; France, Brazil, and Sweden also appear among the first six.

The principal centers of publication (all dates) in the six leading countries and the number of serials published are: Paris, 48; Leningrad, 41; Berlin, 39; London, 33; New York, 19; Rome, 16. However, the relative importance of these cities within their respective

TABLE II—GEOGRAPHICAL SERIALS BY COUNTRY

COUNTRY	ALL DATES		COUNTRY	1950
	No.	%		No.
Germany	254	23.3	Germany	38
U.S.S.R.	113	10.4	United States	31
France	102	9.3	France	26
United States	87	8.0	Brazil	24
Italy	48	4.4	U.S.S.R.	19
United Kingdom	43	3.9	Sweden	14
			Italy	13
Total	647	59.3	United Kingdom	12
57 other countries	445	40.7	Argentina	12
			Poland	10

TABLE III—GEOGRAPHICAL SERIALS BY LANGUAGE OF PUBLICATION

LANGUAGE	ALL DATES		1950		LANGUAGE	ALL DATES		1950	
	No.	%	No.	%		No.	%	No.	%
German	324	29	53	15	Italian	50	5	13	4
English	171	16	72	20	Portuguese	43	4	27	8
French	148	13	48	13	Other	163	15	84	23
Russian	110	10	20	6					
Spanish	83	8	40	11	Total	1092	100	357	100

countries is strikingly different from their absolute numerical importance. London has published 77 per cent of the geographical serials appearing in the United Kingdom, and Paris 47 per cent of those in France; Leningrad and Rome have published about one-third of the serials appearing in the Soviet Union and Italy (36 and 33 per cent respectively); New York has published only 22 per cent, and Berlin only 15 per cent, of the serials in their two countries. The dominating role of London and Paris contrasts sharply with the lesser role of New York and Berlin: in the United States and Germany geographical activity at many widely separated universities and local societies is relatively more important.

Although 25 modern written languages are represented in geographical serials, 85 per cent have been issued in seven languages (Table III). The three languages of traditional international scholarly publication, German, English, and French, lead in that order, with German equaling English and French combined. These three languages plus Russian account for 68 per cent of all geographical serials; Spanish, Italian, and Portuguese add 17 per cent. The remaining 15 per cent have appeared in 18 languages. Among current serials English has replaced German as the leading language, and Spanish has replaced Russian as fourth.

Although in these tabulations equal weight has been given to all serials regardless of the number of years they were published, it is obvious that distinctions must be made on the basis of duration. Among all geographical serials, 386 have been published for less than 5 years; 427 between 5 and 25 years; and 279 for more than 25 years. Only 5 serials have been published under the same title for more than 100 years;³ all combine geography with other subjects, and thus none is a purely geographical serial.

Since the beginning of geographical serials 227 years ago, the number has increased with the development of geography as a field of learning. Cross sections at 50-year intervals reveal this growth. Only 5 serials were published in 1800, and in 1850 only 31 (Table IV). By 1900 the number had jumped to 227, and at the beginning of 1950, 362 geographical serials were being published.

TABLE IV—DISTRIBUTION OF GEOGRAPHICAL SERIALS, 1800, 1850, 1900, AND 1950

In percentages of total

	Europe	Germany	U.S.S.R.	France	U. K.	Italy	Non-European	U.S.	Total
1800	100	80	20	..	.	..	.	.	5
1850	90	42	13	10	10	3	10	.	31
1900	83	24	10	18	4	3	16	4	227
1950	57	10	5	7	3	4	41	9	362

The passing years have been accompanied by a wider regional distribution of geographical serials (Tables I and IV). Of the five current in 1800, four were published in Germany and one in Russia; in 1850, Germany published nearly half, but many other European nations made some contribution; France and the United Kingdom appeared for the first time, with three each. Although Europe published 90 per cent, Mexico, Brazil, and India were also represented. By 1900 the relative importance of Europe, and of Germany within Europe, had declined. Germany still published 24 per cent of the serials and Europe 83 per cent, but new publications were appearing in Anglo-America and Latin America, Africa, Australasia, and the Far East. In 1950 more than 50 countries and 22 languages are represented among current geographical serials (Tables I and III). Europe publishes 57 per cent, Germany only 10 per cent. As serious work in geography has spread throughout the world, the relative importance of any one region, political unit, or language has declined.

The two World Wars altered the patterns of geographical publication. The effects of the Second World War were particularly far-reaching in Germany, where 40 of the 58 serials published at the beginning of the war were suspended or closed. All the geographical serials of the three Baltic states incorporated into the Soviet Union ceased publication. Geographical publication stopped in Poland, and so far only half of the prewar serials have reappeared.

With the return of peace many serials have been revived and others born. Of 362 serials current in 1950, 94 started or resumed publication after 1945. In Germany, 21 new or revived serials have appeared since the war.

³ These serials were published by the Sociedad Mexicana de Geografía y Estadística (*Boletín*, 1839+), the British Association for the Advancement of Science (*Reports*, 1831-1938), and the Verein für Hessische Geschichte und Landeskunde, Kassel (*Mitteilungen*, 1848+, *Zeitschrift*, 1837+, *Zeitschrift Supplement*, 1837+).

DEVELOPMENT OF SOME MAJOR TYPES OF GEOGRAPHICAL SERIALS

Geographical serials may be grouped into broad general categories, such as the regularly issued periodicals of geographical societies, the irregular reports of geographical congresses, independent geographical periodicals, journals of associations of geographers or teachers of geography, numbered occasional papers such as doctoral dissertations issued as contributions from university departments of geography, and bibliographies.⁴

In the mid-nineteenth century popular interest in geographical exploration reached a peak, and geographical societies mushroomed all over Europe. These societies broke new ground in the publication of geographical periodicals. The leading geographical societies of the United States, Britain, France, Germany, Russia, and Italy have published their journals under varying names for periods between 82 and 128 years.⁵ The two longest runs have been published by the Société de Géographie, Paris, whose *Bulletin* and its successors run from 1822 to the present, and the Royal Geographical Society, whose *Journal*, *Proceedings*, and, now, *Geographical Journal* run without interruption from 1830 to the present. The oldest geographical periodical in the Americas is the *Boletín* of the Sociedad Mexicana de Geografía y Estadística of Mexico; it dates from 1839 and is still current.

In the latter part of the nineteenth century geographical congresses began to provide occasional opportunities for geographers, both professional and amateur, to exchange views and to present and publish in a nonperiodical serial a variety of scholarly work. Typically the congresses met once in several years, each time at a different place. The International Geographical Congress dates from 1871, the Deutscher Geographentag from 1881, and the Congresso Geografico Italiano from 1892.

In the 1890's a new spirit of seriousness and scholarship was breathed into geographical publication by the rise of geographical periodicals independent of societies and edited by professionally trained geographers. With the words "The time of the great discoveries of the continental interiors lies behind us"⁶ Alfred Hettner launched his *Geographische Zeitschrift* in 1895. Four years earlier Vidal de la Blache and Marcel Dubois, complaining of the predominance in the geographical journals of popular accounts of explorations in Africa, had started the *Annales de Géographie* with the announcement "The Annales frankly strive for a scientific character."⁷ Similar periodicals were started in the 1890's in Italy and Russia.⁸

⁴ Compare the illuminating summary "Geographical Periodicals" in John K. Wright and Elizabeth T. Platt: *Aids to Geographical Research*, 2nd edit., *Amer. Geogr. Soc. Research Ser.* No. 22, 1947, pp. 66-69.

⁵ United States: American Geographical Society of New York (*Bulletin* and *Journal*, 1852-1915; *Geographical Review*, 1916+).

Britain: Royal Geographical Society, London (*Journal*, 1830-1880; *Proceedings*, 1855-1892; *Geographical Journal*, 1893+).

France: Société de Géographie, Paris (*Bulletin*, 1822-1899; *La Géographie*, 1900-1939; *Acta Geographica*, 1947+).

Germany: Gesellschaft für Erdkunde zu Berlin (*Jährliche Übersicht* . . ., 1833-1839; *Monatsberichte*, 1839-1853; *Zeitschrift*, 1853-1944; *Die Erde*, 1949+).

Russia: Imperatorskoe Russkoe Geograficheskoe Obshchestvo (now Vsesoiuznoe Geograficheskoe Obshchestvo), Leningrad (*Izvestiia*, 1865+).

Italy: Società Geografica Italiana, Rome, etc. (*Bollettino*, 1868+).

⁶ *Geogr. Zeitschr.*, Vol. 1, 1895, p. 3.

⁷ *Annales de Géogr.*, Vol. 1, 1891-1892, p. iii.

⁸ *Rivista Geografica Italiana* (1893) and *Zemlevedenie: Geograficheskii Zhurnal* (1894).

These new periodicals had all been preceded by *Petermanns Geographische Mitteilungen* (1855), which for decades had stood virtually alone in its scientific quality and its breadth of interest in scholarly studies in geography.

The twentieth century has witnessed the rise of associations of geographers, which publish scholarly journals designed primarily for professional geographers: *Annals of the Association of American Geographers* (1911), *Bulletin de l'Association de Géographes Français* (1924), and the *Publications of the Institute of British Geographers* (1935). Associations of teachers of geography have developed simultaneously, and these too have sponsored periodicals; for example, *Geography* (formerly the *Geographical Teacher*) in Britain (1901) and the *Journal of Geography* in the United States (1902).

Universities as such, in addition to the activities of their individual faculty members, have sponsored, edited, and published scholarly series. The German universities were particularly active in geographical publication. In the United States the two outstanding examples are *Economic Geography*, published by Clark University, and the *University of California Publications in Geography*.

Finally, there arose at widely separated dates the specialized geographical bibliographies such as the *Geographisches Jahrbuch* (1866), the *Bibliographie Géographique Internationale* (1891), and *Current Geographical Publications* (1938).

LIBRARY COLLECTIONS OF GEOGRAPHICAL SERIALS

The geographer is closely dependent on libraries in the use of serials, not only because of the large number of titles but also because the long runs of many serials exceed the professional life of any individual. It is important, therefore, to know which libraries have holdings of the various serials. For many geographical series the Union List of Serials⁹ indicates the holdings of each of the leading libraries of the United States and Canada. It thus makes possible an objective rating of the comparative strength of these libraries in the holdings of geographical serials. Because of the wide range in quality and value of such serials, a comparison of the holdings of the major scholarly serials is probably more valid, at least for research purposes, than a survey of holdings of all geographical serials.

The leading libraries of the United States have been rated according to their holdings of major geographical serials (Table V). Twenty serials were selected, four American, four British, four French, four German, two Italian, and two Russian; these were considered to be the outstanding geographical periodicals of international significance in the six countries that have led in geographical publication.¹⁰ The holdings of each library were recorded

⁹ Winifred Gregory, edit.: *Union List of Serials in Libraries of the United States and Canada*, 2nd edit., New York, 1943.

¹⁰ American: *Geographical Review* (including its predecessors, the *Bulletin* and the *Journal of the American Geographical Society*), *Annals of the Association of American Geographers*, *Economic Geography*, and *Current Geographical Publications*.

British: *Geographical Journal* (including its predecessor the *Journal of the Royal Geographical Society*), *Scottish Geographical Magazine*, *Geography*, and *Publications of the Institute of British Geographers*.

French: *La Géographie* (including its predecessor *Bulletin de la Société de Géographie*, Paris), *Annales de Géographie*, *Bulletin de l'Association de Géographes Français*, and *Bibliographie Géographique Internationale*.

German: *Petermanns Geographische Mitteilungen* (including its *Ergänzungsheft*), *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, *Geographische Zeitschrift*, and *Geographisches Jahrbuch*.

Italian: *Bollettino della Società Geografica Italiana* and *Rivista Geografica Italiana*.

Russian: *Izvestiia Vsesoiuznogo Geograficheskogo Obshchestva* and *Zemlevedenie: Geograficheskii Zhurnal*.

from the Union List of Serials; the holdings of the Library of Congress, the American Geographical Society, the University of Chicago, and Syracuse University were revised from present library records.¹¹ Five points were given for a complete set of a serial; sets with fewer than four volumes missing were considered complete. Three points were given for a set more than half complete, and one point for scattered holdings amounting to less than half the total.

It must be pointed out that, with the four exceptions noted, these ratings represent holdings in 1940 and that some libraries attached to young but vigorous departments of geography have strengthened their collections in the last decade. Syracuse University, for which there is a revised record, is a good example. Its rating in 1940 based on the Union List of Serials was 26; based on present library holdings, it is 46; during the past decade the library has actively acquired materials, including a large European collection of periodicals. The exact numerical ratings and ranks of the individual libraries are not given, since the margin of error in reporting was discovered to amount to several points. Furthermore, a different

TABLE V—LIBRARIES IN THE UNITED STATES
RATED BY HOLDINGS OF 20 MAJOR GEOGRAPHICAL SERIALS*

GROUP	SCORES	UNIVERSITY LIBRARIES			OTHER LIBRARIES
		<i>East</i>	<i>Middle West</i>	<i>West and South</i>	
1	89-96		Chicago	California	American Geo- graphical Society Library of Congress New York Public
2	71-76	Harvard Yale Clark	Michigan		
3	54-65	Columbia Cornell Dartmouth	Minnesota Illinois	California at Los Angeles	Boston Public John Crerar (Chicago) U.S. Geological Survey
4	30-46	Syracuse Princeton Johns Hopkins Pennsylvania	Ohio State Cincinnati Wisconsin Nebraska Indiana Northwestern	Louisiana Peabody Stanford Washington	New York State Cleveland Public Detroit Public Newberry (Chicago)

* For the names of the 20 serials see footnote 10. A rating based on minor serials produces similar results. The number of geographical serials of which a library possesses the only recorded complete set in the United States (at least so far as reported in the Union List of Serials or by the libraries cooperating in this survey) measures the strength of the library in little-used serials. The following figures give the number of such holdings for libraries having more than three uniquely complete sets and, in parentheses, the number of serials of which one other library also has a complete set. It will be noted that the three nonuniversity libraries leading in major serials also lead in minor serials and that the four leading university libraries in one lead also in the other, though in a different order:

American Geographical Society: 28 (19)	Harvard University: 10 (10)
New York Public Library: 19 (17)	University of Michigan: 6 (2)
Library of Congress: 18 (10)	University of Chicago: 5 (1)
University of California: 4 (15)	

The University of Chicago, near other large libraries, rarely duplicates an unusual set; the University of California, farther away from other centers, often does.

¹¹ Holdings of the Library of Congress were kindly supplied by Burton W. Adkinson, Director of the Reference Department; those of the American Geographical Society by Nordis Felland, Librarian; and those of Syracuse University by George B. Cressey, Chairman of the Department of Geography.

selection of titles would obviously have given somewhat different results. The gaps between four classes, however, seem to be large enough to reflect major differences in extent of holdings.

Five libraries in the United States are clearly of first rank. With scores of 89 to 96, they are separated from other libraries by a very wide gap. Interestingly enough, four of the five are main types of American libraries. A national government library is represented by the Library of Congress. University libraries are represented by the University of Chicago and the University of California. A municipal public library (or, more strictly, a public reference library) is represented by the New York Public Library. Finally, the American Geographical Society Library is a specialized geographical library of a society. Of these five libraries of first rank, the American Geographical Society Library stands first, and the other four are almost exactly on a par. The general strength of Eastern libraries is indicated by the location of three of the five libraries in the East and only one apiece in the Middle West and the Far West. All five are in metropolitan districts with more than a million population, and the four cities all have strong focal qualities. The Library of the Royal Geographical Society, located in London, the leading center of the British Commonwealth, is also of first rank; on the basis of its records it has a score of 90.¹²

Four libraries in the United States are of second rank. With scores of 71-76, they are clearly more incomplete than the libraries of first rank but still have relatively full collections. All four are university libraries, three in the East and one in the Middle West. Harvard and Yale, the two largest university libraries in the United States, have not specialized in geography but nevertheless have good collections. In sharp contrast, Clark University is a small university library but by specialization in geography has achieved high rank. The University of Michigan, which according to a survey by the American Library Association has more outstanding collections than any other Middle Western library,¹³ is also excellent in geography.

Nine libraries, with scores of 54-65, are of third rank. Five are university libraries—Columbia and Cornell in the East, Minnesota and Illinois in the Middle West, and California at Los Angeles in the Far West. One is a college library—Dartmouth. The other three are of various types: Boston Public, John Crerar in Chicago (public reference), and the United States Geological Survey (government bureau).

None of the other libraries tabulated has a score of more than 50. Libraries with scores of less than 50 do not fall into groups, but at least 18 libraries have scores between 30 and 46. Of these, 14 are university libraries. They are well distributed; four are in the East, six in the Middle West, two in the South, and two in the Far West.¹⁴ Of the four libraries of other types, one is in the East and three are in the Middle West.

PROSPECT

Geographical serials have an honored ancestry and a numerous present family widely distributed among American libraries. That there is vigorous growth is attested by the birth or rebirth of 136 geographical serials in the decade since 1940; this high birth rate is evidence of a widespread and expanding interest in matters geographical.

¹² Holdings of the Royal Geographical Society were generously supplied by G. R. Crone, Librarian.

¹³ As reported in Wright and Platt, *op. cit.*, p. 23, footnote 20.

¹⁴ Not all university and college libraries were checked, and therefore some others may fall in this category.

HUGH ROBERT MILL: AN APPRECIATION*

HUGH ROBERT MILL died at his home in Sussex on April 5 in his 89th year. His life spanned vast developments in the bases of physical geography, the subject of his primary interests. He knew Joseph Hooker, who visited the Antarctic by sailing ship in 1839, and he heard Byrd broadcast from Little America nearly a century later. He followed the momentous changes in upper-air research from the "kite" days of the nineties. He had a share in the production of the Prince of Monaco's bathymetric map of the oceans, a "fine monument of the old period of marine surveying," and he participated in the survey of the English Lakes by the same manual methods, with results confirmed in their essentials by the sonic soundings of 40 years later. His "The Realm of Nature" (1894) and "The International Geography" (1899; American edit., 1909) in a way belong to another age: he himself pointed out that the basis of the former lay in concepts of matter and energy of 50 years ago, hopelessly outdated in the atomic age; and the latter, kept revised up to 1911, was irretrievably outdated by the First World War. But nevertheless they remain landmarks in the history of geography.

Outstanding among Mill's gifts was a fine feeling for words, a poetic sense that shines through all his writings, defying "the tooth of time." And happily he has set down "The Life Interests of a Geographer: 1861-1944: An Experiment in Autobiography." This was written during the war and the typescript sent for safekeeping to Professor George B. Barbour at the University of Cincinnati, who had 100 copies reproduced by mimeograph. One copy is in the library of the American Geographical Society, and the following appreciation of Dr. Mill's work is based on it for the most part. The "experiment" of the title lies in the separate treatment of the main threads of its author's interests—at one time he had thought of calling it "My Nine Lives"—but in fact the several strands are scarcely separable, woven and interwoven as they are into a rich and varied design.

The glimpse into the forces of heredity and early environment is illuminating. Mill was the tenth of eleven children. The Mill forebears were mostly Lowland Scots farmers of the Old Red Sandstone country southeast of the Highlands, but his father's medical practice took him northward, and Hugh Robert was born in Thurso, that town of Scotland's north coast which looks seaward with clear, landless sweep toward the North Pole.

As a young man Mill first felt the lure of chemistry. At the University of Edinburgh he took his degree in chemistry and experimental physics, a never-regretted choice, for, as he said in 1944, "I still believe that a thorough grounding in that science is the best possible foundation for any kind of scientific research, as a training in accurate observation and precise measurement." But the salt of the sea was in his blood, and oceanographic interests came to the fore with a fellowship at the newly established Scottish Marine Station at near-by Granton. J. Y. Buchanan of the *Challenger* expedition was his mentor. John Murray and Wyville Thomson were among other outstanding figures on the scene, and in the course of time Mill here and abroad met many of the leaders in the science of the sea, foreign as well as British—among them Krümmel (with whom Mill wrote the article on oceanography in the 11th edition of the *Encyclopaedia Britannica*), Alexander Agassiz, Otto Pettersson, and Schokalsky. Mill's thesis was written on the chemistry of the waters of the Firth of Forth, but a later and larger effort was devoted to the waters of the west coast, the Clyde Sea area.

* Professor Alan G. Ogilvie has kindly read the manuscript.

It was while investigating salinity and temperature of its tangle of channels and basins that he made the discovery that the temperature distribution was influenced by the form of the basin. It marked a turning point in his interests, giving him a definite bias to geography.

Mill joined the Scottish Geographical Society soon after its founding and took up a teaching position in Edinburgh at the Heriot-Watt College under Francis Grant Ogilvie, giving courses in physiography and commercial geography and writing elementary texts. His methods were advanced, his lectures illustrated with carefully chosen lantern slides, which he eventually gave to Alan G. Ogilvie, together with good advice on a geographical career! He paid much attention to maps and diagrams, discussing new cartographic developments with J. G. Bartholomew. Through meetings of the British Association for the Advancement of Science he came in touch with four confreres also deeply interested in the educational aspects of the science—Keltie, Chisholm, Mackinder, and Herbertson—and together they strove for the better teaching of geography. Mill took an active part in the founding of the Geographical Association in 1893, and it was at the request of the Association that he prepared his "Hints to Teachers and Students on the Choice of Geographical Books for Reference and Reading" (1897; rev. edit., "Guide to Geographical Books and Appliances," 1910).

About this time, Mill records, "the true place of geography as a science" began to obsess his mind. An opportunity for wider exploration of geographical possibilities came with the invitation of the Royal Geographical Society to succeed Keltie in the position of librarian. The offer was congenial, for his love of books had been fostered through omnivorous reading during protracted illness as a child. But he soon found his activities expanded beyond the calls of the library. The time was auspicious: the "work of the old happy-go-lucky explorers was nearly done, and a future of surveying and research was in sight, and the Society was making plans for the training of geographers who could travel and observe." A goodly company of travelers and explorers gathered at the Society's house. It is not far to seek the inspiration that came to Mill for his "International Geography." It was devised on a new plan, each section contributed by an expert—70 in all. Isaiah Bowman recalled it from his student days as "one of my choicest possessions."

"The International Geography" also exhibits Mill's skill as an editor; the "rules for contributors" are instructive. Mill's advent at the Royal Geographical Society was coincident with a change in the form of its magazine, and he himself was given free rein in preparation of an annotated monthly bibliography. Later, he was the logical choice for the laborious though rewarding task of writing the centennial volume, "The Record of the Royal Geographical Society 1830-1930."

During this period at the Royal Geographical Society Mill formulated a great scheme for a complete geographical study of the British Isles on a solid scientific foundation. He presented the project in the *Geographical Journal* under the title "Proposed Geographical Description of the British Islands Based on the Ordnance Survey" (April, 1896) and later prepared a preliminary "sample" study of two of the one-inch Ordnance Survey maps, published as "A Fragment of the Geography of England: South-west Sussex" (March and April, 1900). The plan was praised, but nothing was done. Mill reverted to it in his Herbertson Memorial Lecture of 1921 (*Geogr. Teacher*, Vol. 11, 1921), where he emphasized the important practical applications, especially for water power, afforestation, and agriculture, the while admitting it to be a "seductive dream." Later, in the address "Flashlights on Geography—Featuring Scotland" (*Geography*, Vol. 19, 1934), he referred to the failure to

carry out the plan as "the greatest disappointment of my life as a geographer." Today his dream has in part been realized in Dudley Stamp's Land Utilisation Survey of Britain, and it lies back of many of the concepts of the new Ministry of Town and Country Planning. Moreover, Mill's "Description" led directly to the preparation of regional dissertations by students—first as part of the work for the Oxford Diploma in Geography, and later for degrees in most universities—which now must number many hundreds. The time was not ripe for the necessary collaboration of services of mature scientists that Mill's original plan involved. The regional project, however, was not narrowly conceived. He realized that "the light we flash on one small region may be reflected outwards to illuminate the whole world." In the course of his travels Mill saw a good deal of the world, and he wrote of larger aspects in books and articles; for example, "The New Lands" (1900) and the forward-looking essay on "The Development of Habitable Lands" (*Scottish Geogr. Mag.*, March, 1900). In 1904 Mill was invited to address the International Congress of Arts and Sciences at St. Louis. His topic was "The Present Problems of Geography," and the address was printed in the *Bulletin of the American Geographical Society* (Vol. 36, 1904).

The young Mill had taken meteorological readings with homemade apparatus. He records that for several years as a child he had amused himself "by editing a little monthly manuscript magazine, a feature of which was 'Weather Reports,' copied from newspapers, but illustrated by original graphs of temperature and pressure." One of his duties at Granton was to maintain a meteorological station under the supervision of Alexander Buchan, Britain's leading meteorologist of the day. On arriving in London Mill joined the Royal Meteorological Society and made the acquaintance of that other great rainfall expert, G. J. Symons. Symons had established the British Rainfall Organization and its publication *British Rainfall* in 1860—a unique undertaking, private and voluntary. In 1901 Mill succeeded to Symons' place, resolved to take full advantage of an opportunity for research. He put the organization on a strictly scientific basis, progressively improved the collection and analysis of data and the publication of the results. Between 1900 and 1912 the number of complete records of rainfall increased from 3500 to 5000, and *British Rainfall* grew concomitantly. Most important of his contributions to meteorology was his use of maps as "devices for the computation of rainfall more accurately than by statistics alone," wherein the geographer spoke. His address as President of the Royal Meteorological Society in 1908 was on the subject "Map-Studies of Rainfall." He was at work on the bases of a 50-year average rainfall map when his eyesight failed in 1912. Mill's interest in rainfall was more than a paper interest, however: he met most of the eminent water engineers in the field and participated in many technical and legal discussions of drainage and water-supply problems. His services to meteorology were recognized by the award of the Symons Memorial Medal in 1918, and the newly founded Hugh Robert Mill Prize was awarded to Dr. Mill as the first recipient on the occasion of the Centenary Celebrations of the Royal Meteorological Society (*Nature*, June 3, 1950).

The International Polar Year of 1881-1882 was organized while Mill was a student at Edinburgh. Some years later he first met Nansen, and he was with the Royal Geographical Society when the great Norwegian laid before that body his plan for a polar drift voyage. Mill recalls the obstacles Nansen encountered—"The fine old Arctic admirals tried to dissuade him from so rash an enterprise. Only the plain merchant skipper, Joseph Wiggins, who had traded to Siberia through the Kara Sea, held out any hope"—and the thrill of the safe return. Interest in the Antarctic too was revived. For the six years 1898-1903, says Mill,

"the Antarctic ruled my life." He became intimately acquainted with the ships, personnel, and problems of many expeditions, notably of the National Antarctic Expedition under Scott. One of his last tasks at the Royal Geographical Society was to compile a bibliography for the Antarctic regions, and a little later his book "The Siege of the South Pole" appeared (1905). For a one-sentence description of this admirable book one cannot do better than quote the *Bulletin of the American Geographical Society* (for 1906, p. 269): "a well-knit recital of the whole story of South Polar endeavour, told with literary skill and, of course, with the geographical insight that marks all of Dr. Mill's writings." That history was extended in prefaces to the books of friends—to Shackleton's "The Heart of the Antarctic" (1909) and Rymill's "Southern Lights" (1938). Mill's Antarctic interests never flagged. He was a founder of the Scott Polar Research Institute and a member of its board of directors from the beginning, 1926, to 1940. The American Geographical Society remembers gratefully his prompt response to a request asking him to discuss the significance of Wilkins' Antarctic flights. His commentary was published in the July, 1929, issue of the *Geographical Review*, following Wilkins' own report. It concludes characteristically with a note on the subject of the nomenclature of discoveries: "a theme so tempting and so open to controversy that I feel, like Shakespeare's 'poor cat' the adage, greatly desirous of expressing my views but salutarily cautious as to entering on dangerous ground." Mill had a keen appreciation of the controversial difficulties that seem to be peculiarly rife in Antarctic matters. His was an unwontedly clear and impartial view, and, as the "Life" amply illustrates, he possessed a delightful humor.

It is perhaps true to say that the many threads of Mill's life interests wove their finest pattern in his biographical studies, from the magnificent full-length portrait of Shackleton to the many obituary notices he wrote for *Nature*, most notably his sketches of Nansen, "the greatest man I have known intimately," and Amundsen, "the most successful and the most unhappy of all the Polar explorers whom I have ever met," and the thumbnail sketches that abound in the "Life"—the contrasted figures of W. M. Davis and Albrecht Penck, for instance, or the comparison between the personalities of Scott and Shackleton. In 1937 the editor of the *Geographical Review* addressed a request to Dr. Mill for an analytical discussion of the biographies and autobiographies of a number of explorers. The idea appealed to him greatly but he regretfully declined because of physical disability; he was virtually blind. The biographer in general might well find a model in "The Life of Sir Ernest Shackleton" (1923); the poet, an inspiration in the delicate insight of the epilogue to that volume. It was in a love of poetry that Mill found the unifying thread in writing on Shackleton. The same thread is a clue in his own work. The Cullum Geographical Medal of the American Geographical Society was awarded to Mill in 1929. In his response at the presentation he said: "The design of the Cullum Medal—Discovery looking forward at the prow of a speeding boat—appeals to me powerfully, for my life has been spent in searching out the ways of many waters."

In the conclusion of the "Life" he sums up the main purpose of his scientific work in a single sentence: "The study of the part played by water in the economy of the world through the action of solar heat and terrestrial gravitation raising vapour from the sea and carrying the condensed moisture back over the land, sustaining all forms of life and furnishing hydro-electric power, the only inexhaustible supply of energy." And, he adds, "A complete treatment of this majestic theme would be not merely a scientific treatise: it should rise into the region of poetry and beyond."

GLADYS M. WRIGLEY

GEOGRAPHICAL RECORD

NORTH AMERICA

PREWAR FREE NEGROES. The free Negroes of pre-Civil War America were both spatially and demographically divergent from the much larger slave population. Nature and causes of the differences are examined by Wilbur Zelinsky in "The Population Geography of the Free Negro in *Ante-Bellum America*" (*Population Studies*, Vol. 3, 1950, pp. 386-401).

Although relatively the number of free Negroes decreased after 1810, actually it increased steadily, despite occasional re-enslavement, a trickle of emigration, and frequent "passing" to white status. A majority were freed by manumission; others were escapees to Southern sanctuaries or Northern free territory. These processes were highly selective, resulting in the distinctive demographic composition: more white and Indian admixture than in the slave population and a higher urban ratio; a sex ratio in 1860 of 92.2, as against 100.6 for slaves; and an excess of the aged of both sexes and of nubile females. Reasonable if undocumented explanation is to be found in the illicit relations between master and slave, high regard for old retainers, and superior economic opportunities in cities.

Not until the 1790 census are data sufficient to map the distribution of free Negroes; the principal nodes then fall in a zone extending from southern New England to northeastern North Carolina. At this time of practically universal slavery there was presumably little long-distance migration of freed Negroes.

By 1810 the number of free Negroes had doubled, and the distribution pattern was taking on its climactic form. Chesapeake Bay remained the center of the principal nucleus and the one section having a thoroughly established and considerable colored yeomanry. Except in Charleston and Savannah, there were few free Negroes in the coastal plain south of Pamlico. Recently acquired French Louisiana and Missouri introduced special attitudes and clusters.

Notable after 1810 was the growth of an important nucleus in the Ohio Valley, focus of abolitionists and activities of the Underground Railroad. The eastern littoral remained important, since in that area slavery was either abolished or economically unprofitable. Western Pennsylvania developed a concentration in response to a demand for labor in mine and factory. Free Negroes were few in the deep South, because of the cotton boom; in Arkansas and Mississippi they were legally barred.

The few data on internal migration through 1860 suggest that free-state New York and Philadelphia drew their free colored populations from much the same sources as today, while slave-state New Orleans and Baltimore depended on their immediate hinterlands. Sex ratios show a deficiency of free male Negroes in the slave states, an indication that more females were manumitted and more men managed to escape. Commonly, deficiency in any age group except the youngest means emigration; an excess indicates immigration. A deficiency in the older age groups for Michigan in 1860 means recent arrival; a deficiency of young females in Virginia and North Carolina marks migration to free territory.

With a few exceptions the old clusters of free Negroes lost their identity in the flood resulting from emancipation; at present they are of limited significance. Nevertheless, the understanding of what happened and why contributes a chapter to historical geography and adds to the sum of population theory.—FRED KNIFFEN

SOUTH AMERICA

FROST IN RIO GRANDE DO SUL. It will come as a surprise to many that freezing temperatures are not uncommon even in the coastal region of Rio Grande do Sul, the southernmost state of Brazil, and that killing frosts are a menace to agriculture in sections of the adjoining Argentine province of Misiones. However, Dr. Floriano Peixoto Machado, Brazilian meteorologist, has demonstrated this by an analysis of the records—most of them more than 30 years in length—of 42 well-distributed stations in Rio Grande do Sul (*Contribuição ao estudo do clima do Rio Grande do Sul, Conselho Nacional de Geografia, Rio de Janeiro, 1950*). He reports 31 cold spells between 1909 and 1947, which lasted from 3 to 12 days and brought freezing temperatures to most of the state. Pôrto Alegre experienced 12 spells in which the temperature fell below freezing. Moreover, Dr. Machado reports that 5-to-10-centimeter falls of snow are not uncommon in the Planalto and Serra do Nordeste regions, and depths of 20 to 30 centimeters are recorded on rare occasions. Such is the menace of frost in the Alto Paraná region, including the Argentine province of Misiones, that crops resistant to several degrees of frost play an important part in the agricultural economy (see Herbert Wilhelmy: *Zur Klimatologie und Bioklimatologie des Alto-Paraná-Gebietes in Südamerika, Petermanns Mitt.*, Vol. 94, 1950, pp. 130-139). For his analysis Dr. Machado has divided the state of Rio Grande do Sul into eight regions on the basis of the major physical conditions influencing the climate. His report is accompanied by maps of temperature, rainfall, and snowfall, and by tables in which are presented for each station his summaries of the recorded observations in a wide range of climatic factors.

EUROPE

THE FRANCO-GERMAN BOUNDARY. Because of repeated demonstration of the critical nature of the Franco-German frontier, studies of its evolution are of special interest to the political geographer. A recent examination of bases for creation of a new boundary after the war of 1870-1871 (Richard Hartshorne: *The Franco-German Boundary of 1871, World Politics*, Vol. 2, 1950, pp. 209-250) throws new light on the relative importance of the various factors, particularly iron resources, involved in the exact determination of this often-discussed line. The key to cognizance of the relative weight accorded different factors is a comparison of objectives sought by Germany in the preliminary treaty of February 26, 1871, and those sought in the final treaty of May 23, 1871. Bases for the famous "green line" shown on maps presented in the preliminary treaty discussions were both strategic and ethnographic. Strategically, protection of southern Germany required domination of the Upper Rhine Plain and the eastern slopes of the Vosges Mountains, as well as the fortresses of Belfort, Strasbourg, and Metz, especially the last two. Control of Metz was a *sine qua non* for the German military staff, since it was a strong tactical point and the focus of routes running north to Thionville in the Moselle Valley, overlooked on the west by the Côtes de Moselle, and those following the lowland eastward through the Saar to the Rhine. Ethnographically, Alsace-Lorraine was regarded as an area that rightfully belonged to Germany by historical association and by culture. Bismarck seemed reluctant to violate the ethnographic line (liberally interpreted for Germany) but acceded to military demands to incorporate the non-German area around Metz and Chateau-Salins. Certain *arrondissements*, though rich in iron, were specifically excluded from the proposed area of annexation, since they were neither German in culture nor strategically necessary.

Despite the fact that western Lorraine had by 1870 become the principal French iron-producing region, in all records of German discussions before the signing of the preliminary treaty there is no mention of Lorraine iron as worthy of consideration in determining the new boundary. One definite attempt to impress those in power with the value of the iron resources was a report on Lorraine mines and factories submitted August 18, 1870, by Wilhelm Hauchecorne, director of the Mining Academy in Berlin, but apparently no use was made of it in formulating the decree of August 21 which outlined proposed annexations. Naturally, inclusion of the strategic Metz-Thionville axis in the area to be annexed concomitantly gave Germany much of the iron area.

However, by the time final treaty negotiations began in Frankfurt in May, 1871, the picture had changed slightly. A dispute between the French and Germans regarding the "radius" around Belfort to be left to France, as mentioned in the preliminary treaty, gave Hauchecorne an opportunity to make his influence felt; as a German member of the mixed boundary-demarcation commission, he attempted to have more of the iron ore included both in theory and in the field, but he met with small success. Bismarck did finally demand more of the iron area in western Lorraine, but a contributing factor to the demand was his desire to "rescue" an area of retrogressing German culture. Moreover, the area added to the originally proposed annexation in western Lorraine was offered back to France in exchange for her acceptance of a smaller radius around Belfort; however, after vigorous debate in the French National Assembly, France decided to take the greater radius around Belfort. Apparently the maximum result of all of Hauchecorne's efforts was the added acquisition of Aumetz and one neighboring commune.

Thus nationality and strategy seem to have been by far the chief guiding principles in German decisions on the new boundary; desire for iron resources was definitely of minor importance and brought in little more area than would have been annexed had no iron been present.—COLBERT C. HELD

FOREST CONTROL IN CYPRUS. Although forest is the natural climax vegetation of most of Cyprus, it now covers only about 18 per cent of the island. As has been noted elsewhere in this number of the *Geographical Review* concerning the forests of Palestine (R. O. Whyte: *The Phytogeographical Zones of Palestine*, pp. 600-614), the two great causes of destruction are overcutting and grazing, the latter of which includes not only the damage done by the animals themselves, especially the goats, but also the burning of the hillsides to improve the grazing. To deal with these problems, the Forest Service of Cyprus has developed a varied program (R. R. Waterer: *Forest Report 1949*, Cyprus Government Printing Office, 1950).

Most of the present forest area has been made State Forest, carefully guarded against uncontrolled cutting, and goat grazing has already been eliminated from much of it. To provide a livelihood for the landless graziers, whose free-range grazing on "all categories of land irrespective of the landowner's wishes" has made them parasitic on the rest of the community, they have been given "fair compensation when they agree to give up forest grazing," and when possible they have been given employment on forest works or have been settled as farmers. As an aid in keeping goats out of the forests, and to protect the trees of village areas, villages adjacent to State Forests are encouraged to vote to apply the Goats Law. This excludes free-ranging goats from the village area but allows each family

to keep as many as three tethered goats to supply their own milk needs. Up to the end of 1949 this law had been applied in 39 per cent of the villages.

The elimination of forest grazing "has proved to be the cheapest possible form of reafforestation, for nature quickly takes a hand to restore the forest crop once the goat flocks are removed and natural regeneration again becomes possible." However, where the forest has been so depleted that it cannot renew itself, artificial regeneration is undertaken. In the hill areas this requires stabilization of the soil and simultaneous contour seeding of conifers. With "reasonably good climatic conditions" results have been "outstandingly successful." In the lowlands both planting and seeding of quick-growing species have been carried out, and even very poor barren lands have been made productive. Some of these lowland forests, sometimes planned to fix shifting sands or to reclaim swamps as well as to relieve the pressure on hill forests for fuel, are established as State Forests. Others are Village Fuel Areas, placed under the jurisdiction of the villagers. Because the people feel a sense of ownership there is almost no pilfering and destruction, even though the areas are unguarded. Their development demonstrates to the people the possibilities of growing trees on what has been waste land and stimulates them to plant trees on their own land. This "is transforming the appearance of wide areas of the countryside which till recently were bare of trees."

An unusual undertaking of the Forest Department, to reduce the increasing pressure on the forests enough to permit natural regeneration, is the oil conversion scheme. This plan, calling for conversion to oil or coal by all industrial and commercial users of wood fuel and by some domestic users, was initiated in 1943 when there was a general failure of wood fuel supplies. For four years it proved very successful. In 1948 oil shortages caused by closure in 1947 of the Haifa refinery forced most of the island's industry back to wood fuel, but in 1949 most of the lost ground was recovered, though the high price of oil was a great handicap. Use of wood for fuel is now only about one-fourth of what it was before the conversion to oil was begun.

After "long centuries of every sort of abuse that could wipe out forest growth" the forests of Cyprus are at last being given a chance for renewal and expansion. Without these measures the rapidly growing population, already 126 to a square mile, would soon completely destroy it.

SOIL CONSERVATION IN THE U.S.S.R. In October, 1948, the government of the U.S.S.R. issued a decree providing for long-range development of shelter belts, grass-crop rotations, ponds, and reservoirs in order to secure stable high crop yields in its steppe and forest-steppe areas. These problems were discussed at a Soil Conservation Conference held at Harvard University's Russian Research Center in January, 1949. Papers prepared for that occasion by Joseph J. Bulik, George B. Cressey, Naum Jasny, Dey Ber Krimgold, M. Y. Nuttonson, and Solomon M. Schwarz have now been published (*Soil Conservation in the USSR*, *Land Economics*, Vol. 25, 1949, pp. 333-364).

In spite of their varied specialties, the participants in this symposium all agree on the seriousness of the problems the Soviet program seeks to solve. The area affected includes the most fertile soil in the Soviet Union, but repeatedly crop production on this land has been catastrophically reduced by drought, with the result that yields are among the most variable in the world. Faced both by the prospect of a rapidly increasing population and by the demand

of the people for a higher standard of living, Soviet leaders have advanced this dramatic and comprehensive program to obtain much of the required increase in production of food and agricultural raw materials.

However, in their comments on the feasibility of the program the authors show a significant diversity of opinion, particularly on its probable outcome. None voices the conviction that the measures are certain to succeed—the only officially approved expression in the U.S.S.R. Rather, opinion ranges from extreme pessimism to a cautious “perhaps.”

Professor Cressey argues that man can modify the general climatic picture of any area by no more than 2 to 3 per cent; he would therefore seem to imply that the program cannot accomplish much. Dr. Nuttonson, on the other hand, stressing the fact that the project is based on the results of extensive experimentation by Russian agricultural scientists, points to the precedent set by the successful growth of oak forests in Russia, begun by Peter the Great. Mr. Krimgold notes that some of the evidence available regarding the possible success of the Soviet measures is contradictory and that one must have an enormous amount of knowledge about a whole series of variables and their probability distributions to be able to forecast intelligently in the matter. Dr. Jasny argues that much of the observed increase in yields presented as evidence in support of the ambitious Soviet scheme may be due simply to better management of farms, and he points to the Lysenko controversy as warning of the caution with which Soviet scientific claims must be appraised. Mr. Schwarz, stressing the importance of adverse climatic changes, as evidenced by the recent rapid drop in the level of the Caspian Sea, concludes that the very conditions which create drought in these areas make successful realization of the entire shelter-belt program most unlikely.

Although the symposium reaches no definitive or unanimous conclusions, it provides a valuable exposition of the many complex factors involved in the Soviet program. It is an all too rare instance of cooperative work between social and physical scientists in considering a common problem. It is to be regretted, however, that more emphasis was not placed on the socioeconomic background of the matter, including such factors as the cost to the peasantry, the dictatorial nature of the decision and the probable reactions thereto, and the food problems to be faced in the period before the scheme can be expected to produce results even if its most ardent protagonists are right.—HARRY SCHWARTZ

AFRICA

NEED OF HYDROLOGICAL RESEARCH IN EAST AFRICA. Before “underdeveloped” Africa can be developed, we need to know far more about the physical nature of the “continent of to-morrow’s trouble,” to borrow Mr. J. H. Huizinga’s phrase (*African Affairs*, Vol. 49, 1950, p. 120). This is evidenced at every turn when plans for improvement are advanced. For instance, the East African Rice Mission, which made a field study in Kenya, Uganda, Tanganyika, Nyasaland, and Northern Rhodesia in 1948 (*Colonial No. 240*, 1949), found great difficulty in advising on drainage or irrigation projects because of the “almost complete absence of the essential information and data without which no agricultural or engineer consultant would venture to advise.” As a specific example, for the Tana, which has the greatest irrigation potential in Kenya, “there is nothing in the nature of an hydraulic survey of the river in the middle and lower reaches on which to base firm recommendations for development.” Again, of Nyasaland the investigators, Gerald Lacey and Robert Watson, say that it is “the almost complete absence of reliable hydrological data

which presents the greatest bar to progress." Frank Debenham, who toured the same countries (and Bechuanaland) examining water resources (*Colonial Research Publs.* [No. 2], 1948), likewise was struck by the "many specific problems concerning water which could not be tackled or even properly outlined because of the lack of data." He instances the flooding of the Bangweulu swamps, the cyclic rise and fall of lakes, drainage problems of the Okovango, navigation problems on the Zambezi. Our readers will remember his analysis of the first problem, the Bangweulu swamps, in a recent issue of the *Geographical Review* (July, 1947). The results of further investigation, specifically in regard to rice cultivation, recently carried out by Professor Debenham, may be expected shortly.

Each of the East African countries has its peculiar water problem. In Northern Rhodesia is "the real home of the 'dambo,'" says Professor Debenham, "the small valley-swamp usually due to a combination of low gradient and a vigorous growth of vegetation." In the aggregate the damboes occupy a considerable acreage and because of their inherent fertility would, if drained, make a welcome addition to the cultivable land. Messrs. Lacey and Watson also note the importance of the damboes in any land-development program, and they too caution against ill-considered reclamation measures, for "almost every dambo presents a problem of its own if it is to be properly drained and the drainage water properly applied." In appendixes to his report Professor Debenham deals with the treatment of swamps and of their "converse," the "sand rivers." The sand river, a dry sandy river bed, has a particular importance in Kenya as a subsurface reservoir of water (see also his article, "The Water Resources of Central Africa," *Geogr. Journ.*, Vol. III, 1948, pp. 222-234).

Of all hydrological problems in East Africa, that of Lake Nyasa and its outlet is perhaps the most challenging. The watery "backbone" that should be Nyasaland's great asset is in fact a good deal of a liability. The lake has great capacity—enough to cover all England with 100 feet of water—but the shores lack natural harbors, dangerous storms are frequent, and the fluctuations of the water level, nearly 20 feet, are notorious (see, for example, F. E. Kanthack: *Hydrology of Lake Nyasa*, *South African Geogr. Journ.*, Vol. 24, 1942, pp. 3-34). That periodic blockage of the exit by accumulation of vegetation and silt is a prime factor in the lake "cycle" seems indisputable, though the nature of the phenomenon is not fully determined. If the lake level could be controlled, harbor works could be installed and advantage taken of the natural highway for shipment of agricultural products; lack of transportation facilities is one of the country's chief handicaps at present. Moreover, valuable agricultural land would be restored to permanent use. Lake-level control is complicated by the nature of the outlet, the Shire. In "A Report [1946] on Flood Control and Reclamation on the Lower Shire River and Other Specified Areas in Nyasaland" (London, 1949), A. E. Griffin divides the Shire into five sections. The first stretch has a very flat gradient—Professor Debenham mentions a 10-inch rainstorm in 1946 at Fort Johnson that caused this section of the river to flow both ways for several days. The first rock sill appears at Liwonde, 50 miles downstream. In the third section the river runs through a rocky ravine with hydroelectric potentialities. The fourth reach, to Port Herald, is the lower flood plain, in which the river does not have the capacity to contain even the dry-season flow. The fifth reach, to the Zambezi, partly in Portuguese territory, has the further complication of seasonal flooding from that great artery. Mr. Griffin has three suggestions for control of the lower river: enlargement of the present channel, banking, basin reclamation. Pending further investigation and experimentation he describes them as "hypothetical."

In the January, 1949, issue of the *Geographical Review* we noted the interim report on a comprehensive plan for the Sabi-Lundi region of Southern Rhodesia. The final report of the consulting engineers has now appeared (Sabi-Lundi Development, June, 1949). One of the chief topics dealt with is, of course, water and its availability, and one of the appendixes is an account of the climate of the low-veld region by J. S. Peake. Rainfall records are described as adequate, but "very little information is available on which an accurate estimate of run-off can be based." River gauging stations have been established, but it will take time before sufficient data can be amassed to be useful. Comparative studies give little help: "our researches have confirmed that it is most dangerous to draw conclusions based on similarity of rivers in other countries. There is no short cut to the actual measurement and computation of run-off on the spot."

AN EXPLOSION CRATER IN THE WESTERN SAHARA. Although a great many craters have been described in the Libyan Sahara, until recently none were known in the western Sahara. During World War II aerial photographs taken by the United States Air Force revealed such a feature south of Tenoumer, in northwestern French West Africa ($22^{\circ} 55' \text{ N.}, 10^{\circ} 24' \text{ W.}$), and a ground reconnaissance showed it to be an explosion crater, probably late Quaternary in age (J. Richard-Molard: Un crater d'explosion dans le Sahara occidental: Le Guelb Tenoumer, *Rev. de Géogr. de Lyon*, Vol. 24, 1949, pp. 308-318).

The country surrounding the crater is extremely arid—a shower in 1947 was the first rain in 15 years. The level surface truncates intrusive and metamorphic rocks, capped in places by nearly horizontal layers of limestone, commonly cherty and nowhere more than 20 meters thick. The crater rim, a nearly perfect circle 1800 meters across and about 100 meters above the surrounding desert plain, consists of fragments of bedrock rather than of volcanic ejecta. There are no extensive lava flows, though some isolated fragments of unweathered basalt are scattered over the outer slopes of the crater.

Professor Richard-Molard believes that this crater, together with another recently discovered explosion pit 195 kilometers to the northeast, indicates the presence of a fault that roughly parallels the margin of the Atlas Mountains bordering the Sahara. He also points out that a relationship may exist between this postulated fault and a troughlike flexure in the lines of equal magnetic intensity that cross this part of the Sahara. More field work seemingly will be necessary to establish the existence of such a tectonic feature.—W. C. PUTNAM

ASIA

AGRICULTURE IN TAIWAN. The *Taiwan Agricultural Yearbook*, published by the Japanese administration from 1920 on, is now being issued by the Department of Agriculture and Forestry of the Taiwan Provincial Government. The volumes for 1948 and 1949 (Taipei, November, 1949, and January, 1950), in Chinese and English, contain much the same data as their predecessors, with the welcome addition of information on marine products and the unwelcome omission of certain figures on land tenure.

In 1948 the arable land totaled 863,157 hectares—23.19 per cent of the island and the largest amount since 1939. However, the greatest rate of expansion was in dry fields rather than in paddy. Does this mean a spread upslope against the forests? Increases in area were outstanding for the following dry-land crops: dry rice, sweet potatoes, barley, wheat, millet, sweet corn, soybeans, peanuts and other sources of vegetable oils, cassava, hemp, and vege-

tables. Large decreases since 1939 have occurred especially in pineapple and mulberry, and also in tea, ramie, jute, cotton, and most citrus fruits.

The total rice yield for 1948—960,000 tons—slightly exceeded that of 1944. Yield per hectare was lower by almost one-quarter, but this was compensated by an increase of one-fifth in rice lands. Gains in area and yield since 1945 have been marked, but yield is still about one-third less than in 1939, when much more fertilizer was used.

In the long battle between rice and sugar in Taiwan, rice is still in the lead, but cane cropland is increasing. In 1948 it totaled 85,000 hectares, which is only half the banner planting of 1940 but about two and a half times that of 1946 and 1947. How much more it will gain, especially in competition with the rice needs of Taiwan's large population, is a question of significance to the island's whole economy. The figures of yield per hectare suggest that sugar cane is being fertilized, and this, in turn, suggests that sugar is being exported. Unfortunately, the fertilizer tables do not show distribution by crops, nor are there tables of crop uses and exports.

One of the most informative tables is that of percentage of value of all agricultural products by class and crop. In 1948 the most important crops were rice, 42.5 per cent of the total value; sweet potatoes, 20.2 per cent; and all sugar cane, 11.2 per cent (the commercial type was 6.9 per cent). Surprisingly, if marine products were listed with the crops, sugar cane would have to step down one notch in the ranking.

Population composition in terms of occupations differs greatly from that generally accepted for China as a whole. In 1948 farm population made up 56 per cent of the total of 6,807,233, whereas 1.2 per cent, or 78,791, were in marine industries. Figures of land tenure in 1948 are not very different from those of the past 10 years: 35 per cent of the agricultural population were owners, 26 per cent part owners, and 39 per cent full tenants. More detailed figures on such matters as absentee ownership, sizes of farms, and rents are not given for the years since 1939.

In compilations such as these one must read with some care, because of problems that are familiar to everyone who deals with agricultural statistics. Comparisons of monetary values of crops from year to year are affected by currency changes and inflation. The data themselves often show discrepancies, perhaps largely because they are gathered through administrative channels rather than by direct field work. However, considering the problems and cost of collection, compilation, and publication in the present situation, geographers should be grateful for these volumes and whatever light they shed on recent changes in Taiwan's land use and crops.—THEODORE HERMAN

AUSTRALASIA AND OCEANIA

EXPEDITIONS TO ARNHEM LAND, AUSTRALIA. The first report of the recent expedition to Arnhem Land, North Australia, sponsored by the National Geographic Society and the Smithsonian Institution in cooperation with the Australian government has again focused attention on the little-known Stone Age dwellers that inhabit the area (Charles P. Mountford: *Exploring Stone Age Arnhem Land*, *Natl. Geogr. Mag.*, Vol. 96, 1949, pp. 745-782). The expedition had at its disposal the latest methods of radio communication and modern means of air transport. It is not yet known how far inland the scientists ventured, but this first report indicates that they worked from bases close to established mission stations.

While this investigation was being carried out, an account appeared of a journey by Donald F. Thomson, made before the outbreak of the last war (Arnhem Land: Explorations among an Unknown People, *Geogr. Journ.*, Vol. 112, 1948, pp. 146-164 [published in April, 1949]; Vol. 113, 1949, pp. 1-8; and Vol. 114, 1949, pp. 53-67). It is a remarkable story of great daring and courage by an Australian anthropologist who has shown himself willing to risk his life in the cause of scientific research. It took Thomson 12 months to persuade the Commonwealth government to allow him to undertake this special mission, and it was apparent that few expected him to return. In many ways his experiences were similar to those of the explorer John Eyre in the first journey made across the desert regions of central and western Australia in 1840. Both men were accompanied only by aborigines, of whom all but one deserted because of the severe hardships and fear of the dangers ahead. The one companion who remained with Thomson fell sick during the journey.

In his two years and a half in Arnhem Land, Thomson won the confidence of the aborigines and thus was able to collect valuable anthropological data, including information on the methods by which these primitive people have adjusted themselves to their particular environment and early cultural contacts between the aborigines and voyagers from Macassar. The geographical results of the expedition included the discovery of the great Arafura Swamp and the exact location of many rivers and parts of the coast line which were mapped for the first time. In recognition of his valuable contributions to both the anthropology and the geography of Arnhem Land, the Royal Geographical Society awarded Thomson the Cuthbert Peek Grant for 1948.

From Thomson's accounts the aborigines of Northern Australia are far from being a shiftless and improvident people. They classify their land into types or formations according to seasonal changes in the vegetation, and the annual cycle is divided into five or six well-defined periods based on climatic variation. During the wet season, December to March, the lowlands of Arnhem Land are flooded, and the aborigine sets up his camp close to his source of food. The long grass and dense vegetation afford protection for wallabies and other game and at the same time give the hunter cover when stalking his prey. The vegetable foods that are his staples in other seasons become scarce and unpalatable, since the ground is waterlogged and sodden. He therefore becomes a fisherman-hunter, and his travels over the grass flats between streams are both difficult and uncomfortable. The vegetation provides a refuge for giant venomous snakes and a cover for countless mosquitoes. These latter appear in incredible numbers, and the natives are forced into their houses before nightfall to seek the protection of fires. House types are closely related to the season. When there is need for protection from insects, the aborigine often becomes a tree dweller, using a sleeping platform on or under which he keeps a fire burning to maintain a constant smoke screen. The house on stilts serves the same purpose and is thought to resemble certain primitive types in Papua. In the dry season, April to August, the natives are nomadic, and the only protection they require is gained from a lean-to made out of brush. The practice of burning the grass is carried out with the greatest care, since it destroys many of the valuable vines and food plants. When the harvest is well advanced, the grass is fired, not at random but in limited areas and under careful control. By this device it is easier to hunt down wallabies, bandicoots, native cats, goanas, and snakes, the last of which are relished for their fat and their eggs. Primitive man, without any domesticated plants or animals, is dependent on his own efforts as hunter and gatherer, and as such the aborigine of Northern Australia

has clearly demonstrated an almost scientific appreciation of his immediate environment.

World War II brought many changes in the lives of the native inhabitants of Arnhem Land, and time alone will tell whether these have hastened the doom of a Stone Age culture. It is all the more valuable, therefore, to have recorded the results of scientific investigations of the few aborigines remaining in their natural habitat. It has been my privilege to know Donald Thomson for the past 12 years both in England and in Australia. Through his exploration and field work he has made a unique contribution to an understanding of the relationship of the aborigines to their environment in Northern Australia. His forthcoming book, to be published by the Melbourne University Press, will no doubt throw more light on this complex relationship.—GRAHAM H. LAWTON

MAPS OF TASMANIA. In connection with Griffith Taylor's article, "Hobart to Darwin: An Australian Traverse," in this number of the *Review*, it is of interest to note that the American Geographical Society has just received a useful collection of maps from the Tasmanian government. These include a "Tourist Map of Tasmania," 12 miles to an inch (1950?), showing roads, railroads, airdromes, mountains, and caves on a hypsometric base; a "Sketch Map of Geology" by the State Economic Planning Authority, 16 miles to an inch (1947); a state map 8 miles to an inch (1946) and a state map 4 miles to an inch (1944) in six sheets; "Commonwealth Electoral Divisions and Subdivisions," 7½ miles to an inch; and a sample of the map based on aerial survey, 1 : 15,840, covering the Longford area, with 50-foot contours. A lively account of the survey, under contract since early 1946, was given in *Walkabout* for October, 1948. Progress on this and other mapping activities may be followed in the *Report of the Surveyor-General and Secretary for Lands*, issued annually at Hobart. The geology map is a later edition of Plate 13 in "Regional Planning: Economic Resources of Tasmania," published by the State Economic Planning Authority, Hobart, 1945. Reference may also be made to J. Gentilli's map of "Climatic Regions" (1947) in the State Economic Planning Authority series.

THE BIKINIANS. The natives of Bikini Atoll, in the northern Marshall Islands, have the same language, customs, and physical characteristics as the other 10,000 inhabitants of the some 30 atolls that make up the Marshalls. However, the natural resources of Bikini are meager compared with those of the wetter, richer southern islands. There were, therefore, only 167 natives on the atoll in 1946, when they were removed by the United States Navy Department to make way for experiments in atomic bombing. Leonard Mason has told the story of their wanderings from that time until late 1948, when, increased to 184, they were settled on Kili Island, in the southern part of the Marshall group (The Bikinians: A Transplanted Population, *Human Organization*, Vol. 9, 1950, pp. 5-15).

A sojourn on Rongerik Atoll, which at first seemed suitable for colonization, proved disappointing to the Bikinians. Its reputation throughout the northern Marshalls as an undesirable place in which to live was adequately borne out by experience. It had had no permanent inhabitants, and for any island in the Pacific that fact is indicative of insufficient natural resources. During their two years on Rongerik, the Bikinians eked out a frustrated existence from meager coconut palms, unproductive breadfruit, and plantains. In depressed spirits and weakened physical condition they were then removed to Kwajalein. Here for nearly a year they were housed in a tent village and fed on navy rations while the administration pressed its search for a permanent home.

Kili Island and Wotho Atoll were both found to be feasible and acceptable to the administration. Finally Kili, 230 acres in extent, isolated, and with no lagoon, was chosen because of its more agreeable climate and greater natural resources. At the time of colonization it possessed large groves of excellent breadfruit trees, bananas, and papayas; and several low, swampy areas were ideally suited to the cultivation of taro. Under prewar Japanese management coconut palms of superior quality had been planted, and more than 60 tons of copra had been exported annually. No one had lived on the island since the war; it belonged to the United States as former Japanese property and was not subject to control by any paramount chief.

At Kili new homes, of solid frame structure, were erected under the supervision of a navy carpenter. Although the administration left food supplies sufficient to tide the settlers over the initial period of adjustment, the Bikinians began immediately to utilize the resources of the island. A good beginning has thus been made on the material side of the colony's existence on Kili. A program of education is needed to help the newcomers learn to handle small craft in rough surf (since they have no lagoon) and to cure copra by artificial heat during the frequent spells of rainy weather.

Among the factors involved in relocating the Bikinians was the need to provide for an increase in population, a phenomenon now noted on many islands in the Pacific. As medical personnel work efficiently to preserve lives, and as missionary teaching against abortion and other checks to increase becomes more effective, land for settlement by the expanding communities becomes increasingly scarce. Between the First and Second World Wars the increase in population in the Gilbert Islands, urgently pressing on the available food supply, was taken care of, at least temporarily, by transporting some 2000 natives to islands in the Phoenix group, where they formed new colonies. Since the United States took over the government of American Samoa in 1900, the population there has more than doubled. In the Marshalls as well as in the other islands they administer in the Pacific, Americans will have to plan to meet problems resulting from overpopulation and will have to devote more attention to working out possible solutions.—JOHN WESLEY COULTER

POLAR REGIONS

WHALING AIDS METEOROLOGY. A century ago whaling expeditions provided almost all the geographical information about sub-Antarctic islands and waters, and in the last few years their modern counterparts have been furnishing valuable and generally reliable summertime meteorological and oceanographical information for the same oceans. The resumption of whaling after a six-year wartime interval took trained meteorologists into areas that were little known. Their reports, some only observational and others fitting their own data into the hemispheric weather pattern, have helped fill in a blank spot in meteorological knowledge.

Such information has been obtained, in the first three postwar seasons, by British, Dutch, Russian, and Japanese whalers. For some reason the foremost whalers of all, the Norwegians, have not followed this trend and seem to have sent no meteorologists or oceanographers with their ships; however, years ago they pioneered in compiling, as part of their Polar Year contribution, "Meteorological Observations Made on 9 Norwegian Whaling Floating Factories during the International Polar Year 1932-33" (Det Norske Meteorologiske Institutt, Oslo, 1935).

Most prolific of these whaling meteorologists is H. H. Lamb of the British Meteorological Office. From his observations aboard the *Balaena* in 1946-1947 along the Indian Ocean coast of Antarctica he deduced (Scientific Results of the "Balaena" Expedition 1946-47, *Meteorol. Mag.*, Vol. 78, 1949, pp. 104-112) that groups of cyclones seem to form at spacings of 60°, 90°, or even 120° of longitude apart, varying with the strength of the westerlies ("zonal index"). He also observed that weather systems in this area behaved as though there were "a topographical barrier . . . 12,000 to 15,000 feet in height" extending southwestward from about 70° S., 97° or 100° E., to the vicinity of 80° S., 80° E. (Topography and Weather in the Antarctic, *Geogr. Journ.*, Vol. 111, 1948, pp. 48-66).

During the same first postwar whaling season the *William Barendsz* is understood to have obtained some 90 radiosonde observations in the northern Weddell Sea, but no published account has yet come to notice, and it is not known whether this or any other Dutch whaler continued such scientific work in subsequent seasons. Russian whalers have been active each season in the same area. On the "second trip of the first Soviet whaling fleet" meteorological and oceanographical observations were made primarily in search of correlations to guide the whalers in locating their prey (G. M. Tauber: *Plavanie v Antarktich v 1947-48gg* [Voyage to the Antarctic in 1947-48], *Vsesoiuznoe Geograficheskoe Obshchestvo Izvestiia*, Vol. 81, 1949, pp. 369-385). The tabulation of observations is similar to weather summaries for other whalers, such as C. Minchin's "Weather and Pack-Ice Encountered During the Season 1948/49 in Antarctic Waters" (*Marine Observer*, Vol. 20, 1950, pp. 50-51).

Professional meteorologists and oceanographers have been carried on Japanese whalers since the war (Oceanographical Section, Central Meteorological Observatory: Report on Sea and Weather Observation on Antarctic Whaling Ground [1947-48], *Oceanogr. Mag.*, Vol. 1, Tokyo, 1949, pp. 49-88; *idem*: Report . . . [1948-49], *ibid.*, pp. 142-183. Mobility of the whaling fleet, putting it in different waters in different months, makes the painstaking climatic tabulations of only passing interest: differences between the various periods into which the data are grouped may be due either to location or to season, if not to both. The conclusions concerning the general weather processes, presented in the report of the third season, are sound and confirm the results of other recent students, though the Japanese meteorologists apparently had read no other reports or discussions on the subject; their only reference to previous data is a mention of weather conditions in the Bay of Whales in 1911—when a Japanese expedition visited there.

They agree in general with Lamb, and with the findings of the Australians after the first year of their operation of fixed stations on Heard and Macquarie Islands (W. J. Gibbs: A Period of Analysis for the Southern Ocean and the Implications in Southern Hemisphere Circulation, *Weather Development and Research Bull.* [Australia], Vol. 12, 1949, pp. 5-42). They also are in accord with the conclusions of United States Navy aerologists (Aerology, Flight Section, Chief of Naval Operations: Reports from Operation Highjump, NAVAER 50-50T-1, June, 1947; *idem*: Aerological Aspects of Operation Highjump, NAVAER 50-45T-6, Nov., 1947, Restricted; *idem*: Aerological Observations and Summaries from the Antarctic from 15 December 1946 to 15 March 1947, NAVAER 50-1R-214, Jan. 1948; *idem*: Aerological Aspects of the Second Antarctic Development Project, NAVAER 50-45T-10, Sept. 1948, Restricted).

Findings of these four separate sources—British, Japanese, Australian, and American—fit the concept of two frontal regions over the extreme southern Indian Ocean and the waters south and southeast of Australia and New Zealand, at least in summer. One of these,

TABLE I—ANTARCTIC AND SUB-ANTARCTIC WEATHER STATIONS
ACTIVE IN 1950 (SOUTH OF 45° S.)

LAT. S.	LONG.	STATION	LOCATION	NATIONALITY
<i>Antarctica Proper</i>				
71°03'	11°00'W	Maudheim	Kap Norwegia, Queen Maud Land	Nor.-Brit.-Swed.
66°45'	141°00'E	Cap de Margerie	Adélie Land	French
<i>Palmer Peninsula</i>				
65°15'	64°16'W	Argentine Is.	Off west coast	British
64°50'	63°31'W	Port Lockroy	Wiencke Is., west coast	British
64°19'	62°58'W	1° de Mayo	Gamma Is., Melchior Ar.	Argentine
63°19'	56°54'W	Base O'Higgins	Cape Legoupil	Chilean
<i>South Shetlands</i>				
63°00'	60°30'W	Isla Decepción	Port Foster	Argentine
62°59'	60°34'W	Deception Island	Whalers Bay	British
62°30'	59°41'W	Bahia Soberania	Greenwich Island	Chilean
62°05'	58°33'W	Admiralty Bay	King George Island	British
<i>South Orkneys, South Georgia, Falkland Is.</i>				
60°44'	44°44'W	Orcadas del Sud	Scotia Bay, Laurie Is.	Argentine
60°43'	45°36'W	Signy Island	South Orkneys	British
54°16'	36°30'W	Grytviken	South Georgia	British
51°42'	57°51'W	Port Stanley	Falkland Islands	British
<i>East Sub-Antarctic Islands</i>				
54°30'	158°57'E	Macquarie Island	Southwest of New Zealand	Australian
53°06'	72°31'E	Heard Island	South Indian Ocean	Australian
52°32'	168°59'E	Campbell Island	South of New Zealand	New Zealand
49°20'	69°16'E	Port aux Français	Kerguelen Island	French
46°51'	37°52'E	Marion Island	Prince Edward Islands	South African

NOTE. All bases are intended to be permanent except Maudheim, which is for three years. Positions of Maudheim and Cap de Margerie supplied by respective expedition headquarters; other positions taken from *International Meteorological Organization Publication No. 9*. The Argentine station on South Georgia closed after the FIDS station was established near by. Two FIDS stations were inactive in 1950: Marguerite Bay (68°12' S; 67°03' W) and Hope Bay (63°24' S; 56°59' W).

the Austral or Southern Polar Front, trends east-southeast from a point south of Madagascar to the Ross Sea south of New Zealand; along it travel groups of cyclones, deepening, occluding, filling, and regenerating, and eventually dying in the Ross Sea. The other is the Antarctic Front, which exists in segments around Antarctica; weak cyclones occasionally form on it and move eastward, and occasionally it is bulged northward by the outflow of a cold air mass from the continent, preferably just west of the Balleny Islands along the coast where Sir Douglas Mawson found "The Home of the Blizzard" and where a French expedition is currently wintering, at Cap de Margerie.

That conditions are similar along other coasts of Antarctica is apparent from the High-jump discussions, from a recent analysis of the results of John Rymill's British Graham Land Expedition 1934-1937 (S. T. A. Mirrlees: Notes on Southern Hemisphere Circulation,

Meteorol. Mag., Vol. 78, 1949, pp. 315-321), and from the only meteorological report so far available on the six-station network of the Falkland Islands Dependencies Survey, begun in 1944 (G. de Q. Robin: Notes on Synoptic Weather Analysis on the Fringe of Antarctica, *ibid.*, pp. 216-226). A popular account of a year at one of the FIDS stations is given by David James in "That Frozen Land: The Story of a Year in the Antarctic" (London, 1949).

Oceanographical observations of the Japanese whalers likewise are not in disagreement with the extensive findings of R.R.S. *Discovery*. Although there were marked variations in surface temperature and salinity from year to year and even from day to day, the 70 soundings made during the three consecutive years show remarkable constancy of conditions below the surface. But they do reveal the great complexity of the Antarctic Convergence, which is hardly the smooth east-west line often imagined. At a depth of 75 meters warm currents appear to sweep south over the submarine ridges of Scott Island and the Balleny group, with cold currents flowing northward between them; the pattern is similar, but less pronounced, at 300 meters.

The economic value of such observations is pointed out: whaling is best along the boundaries between the warm and cold currents. However, "position of current boundary shifts little every year, but good whaling field in the last year is not always a good whaling field in this year," because good whaling depends "not only on hydrographical factor but on distribution of planktons, especially of krils (*Euphasia superba*) which are good to lead whales and the field exists on the path of whale migration. There are still many problems to be studied in future concerning these relations."

Whaling's first postwar year not only brought a wealth of sub-Antarctic meteorological data (for example, more than 400 radiosonde ascents, United States and Dutch combined) but also is the subject of two books about the whalers and another about Operation Highjump (David R. McCracken: *Four Months on a Jap Whaler*, New York, 1948; John Grierson: *Air Whaler*, London, 1949; William J. Menster: *Strong Men South*, Milwaukee, 1949).

All these, however, are summertime experiences, summertime observations. Thanks to them, summertime conditions over and under the sub-Antarctic oceans are now fairly well known, so that they even find their way into fiction (Hammond Innes: *The Survivors*, New York, 1950). But for wintertime conditions, and the variations of weather through the year, many more observations are needed. Although the score or so of Antarctic and sub-Antarctic weather stations that operated during the 1950 winter (see table) will provide much valuable information, there will still be a great gap over the oceans; there winter weather is far too rigorous for scientific expeditions, or even for whaling.—ARNOLD COURT

PHYSICAL GEOGRAPHY

NEW PUBLICATIONS IN THE FIELD OF METEOROLOGY. In response to an increasing demand for information concerning the contemporary meteorological publications of all parts of the world, the American Meteorological Society has initiated a new monthly periodical, *Meteorological Abstracts and Bibliography*, of which the first number appeared in January, 1950. The fields to be covered will be limited to "that branch of Geophysical Science which deals with the Atmosphere and its boundaries; to applications of astrophysics, geophysics, mathematics, mechanics, oceanography, statistics and thermodynamics which will help the meteorologist solve his problems; and to applications of meteorology and climatology which will help the specialist in aeronautics, agriculture,

aviation, commerce, forestry, hydrology, industry, insurance, medicine, teaching, military or naval science, etc., solve his problems." Abstracts, arranged under subject headings, cover not only current publications but also material "transmitted by any means or medium," including lectures, manuscripts, and radio and television programs. Emphasis will be placed on material difficult of access for the average reader. In addition to the abstracts, each number contains a listing of the contents of the latest meteorological journals and author, subject, and geographical indexes. Twice a year cumulative author and subject indexes are to be published. In the bibliographic field each number contains a cumulative annotated bibliography on some special subject "of vital concern to large numbers of meteorologists today." Topics covered to date are: atmospheric pollution; aerobiology; artificial precipitation and cloud physics; hail; tornadoes; volcanic dust; climatic changes. Future numbers will treat such topics as thunderstorms, icing, energy exchange in the atmosphere, and long-range forecasting.

In January, 1950, the India Meteorological Department inaugurated a quarterly publication, *Indian Journal of Meteorology and Geophysics*, to facilitate prompt and regular publication of Indian contributions, both popular and scientific, in these fields. Major articles in the first number cover such topics as the forecasting of Indian rainfall, the use of geophysics in mineral exploration, the effect of height and latitude on distribution of saturation potential temperature, reflection of sound waves from the stratosphere, and microclimatic statistics. Each number will include notes and letters on recent developments and work in progress and a brief review of important weather events in recent months.

HUMAN GEOGRAPHY

THE CULTURAL ASSIMILATION OF IMMIGRANTS. To the historian and the geographer and to those specialists who class themselves as social scientists, a human culture, with its manifold and subtle variations and its emotional biases, defies classification and analysis in all but its rougher external attributes. Its complexities, however, increase many times under the impact of an immigrant group. Thus we have the problem of the cultural assimilation of immigrants, discussed by a group of demographers of the International Union for the Scientific Study of Population meeting in Geneva from August 27 to September 3, 1949, under the auspices of UNESCO (Cultural Assimilation of Immigrants, *Population Studies*, March, 1950, Supplement). The Union agreed to study this problem as its first long-term postwar research project.

Contributions to the discussion were made by 22 demographers—five from France, three each from Great Britain, Switzerland, and the United States, two from Italy, one each from Argentina, Belgium, Brazil, Germany, and Israel, and one representative of the United Nations. Seven of them presented papers. These, and the introductory summary by D. V. Glass, are valuable for the subject matter they encompass, the analytical wisdom they contribute, and the array of research techniques they illustrate. Most important on the methodological side are two papers. In "Statistics for Studying the Cultural Assimilation of Migrants" Max Lacroix and Edith Adams show the manner in which censuses, international migration statistics, vital statistics, and other classes of statistics from both official and unofficial sources can be used and provide detailed tables showing which of such data are available in the most recent censuses of some 49 countries. The other paper is a valuable "Scheme for an International Study of the Degree of Immigrant Assimilation," by Henri Bunle, which presents a detailed questionnaire for use among immigrants. In point of subject matter, special attention

is directed to the papers by Julius Isaac, "Problems of Cultural Assimilation Arising from Population Transfers in Western Germany," and Roberto Bachi, "Statistical Research on Immigrants in the State of Israel," both of which provide new data and insight into two acute problems of immigration where the rate of influx is choking the process of assimilation. The remaining papers, by Henri Bunle, Georges Mauco, Giorgio Mortara, and Franco Savorgnan, are all concerned with definitions of the cultural assimilation of immigrants; refined measures of the degree of assimilation; and the detailed interaction between the immigrant, the host country, and the continuing cultural ties of the mother country.

These papers point the way and provide a beginning for the future concerted research effort planned by the International Union (although admittedly valuable work has already been done by M. R. Davie, K. Davis, D. V. Glass, J. Hope Simpson, J. Isaac, C. V. Kiser, C. Senior, and L. E. Truesdell). Geographers should continue to acquaint themselves with the work of demographers and make use of the refined population data from their cultural evaluations.—MALCOLM J. PROUDFOOT

THE CARTA MARINA OF OLAUS MAGNUS. A noteworthy supplement to Dr. Edward Lynam's treatise of this title, reviewed in a recent number of the *Geographical Review* (Vol. 40, 1950, pp. 160-161), has appeared in the form of a new facsimile of the Carta Marina. Dr. Josef Haglund of the Royal Library in Stockholm, Sweden, has published the map as a colotype, on nine sheets of hand-made linen-rag paper, pale amber in tone. If these are mounted together, the map, like the original, measures 170 by 125 centimeters. A tenth sheet shows the entire map on a reduced scale. Dr. Haglund hopes to publish eventually a commentary on the map and a Swedish translation of the "Opera breve," the explanatory booklet issued by Olaus Magnus with the map in 1539. As the key is an integral part of the Carta Marina, it is to be hoped that Dr. Haglund will find it possible to publish an English translation as well. The facsimile may be obtained from Dr. Haglund at the price of ten dollars.

GEOGRAPHICAL NEWS

MEETINGS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS. Clark University played host in Worcester, Mass., to members of the Association of American Geographers at their forty-sixth annual meeting, April 5 to 8, 1950. Two days and a half and one evening were devoted to papers and discussions; half a day to a lively business session. Professor Richard Hartshorne delivered his presidential address, "The Functional Approach in Political Geography" (since published in the *Annals of the Association of American Geographers*, June, 1950), at the annual banquet, held on Friday evening, April 7, at which Shannon McCune, retiring vice-president, presided.

Several special sessions were scheduled by the program committee under the chairmanship of Edward Ullman. On Wednesday afternoon seven papers were presented in a symposium on resource management, arranged by Edward Ackerman. Four of these dealt with resource problems in specific areas, three with more general considerations, including a discussion of the role of resource development in the Point Four program. The hundredth anniversary of the birth of William Morris Davis was marked by a symposium meeting on Thursday morning, arranged by Kirk Bryan. To open the session, Lawrence Martin, a former student of Davis', drew on his own fund of anecdote to illuminate his presentation of

"William Morris Davis as a Teacher and Leader of Geomorphology." Discussions by Kirk Bryan on "The Place of Geomorphology in the Geographic Sciences," Arthur N. Strahler on "Davis' Concepts of Slope Development Viewed in the Light of Recent Quantitative Investigations," and Louis Peltier on "The Geographic Cycle in Periglacial Regions" continued the session, and two papers were read by title only—"Tectonic Relief," by the well-known New Zealand geomorphologist C. A. Cotton, and "William Morris Davis as a Master of Method," by Professor Henri Baulig of France. A third special session was the round table on cartography, held on Thursday evening and arranged by Erwin Raisz.

In addition to the symposia, some 40 papers were read in the course of six concurrent daytime and evening sessions. Seven dealt with economic geography, six with cultural and settlement geography, six with physical geography, five with urban geography, five with political and regional geography, five with cartography and photogrammetry, and the remainder with historical, bibliographical, or miscellaneous subjects. Time was allowed for discussion of all papers, and the procedure initiated last year of advance circulation of papers among selected individuals for the purpose of stimulating and guiding the discussions was again followed. A helpful innovation this year was the publication of abstracts of all papers in the program for the meetings. These abstracts have since appeared also in the *Annals* (June, 1950).

The following officers were elected for 1950: G. Donald Hudson, president; Raymond E. Murphy, vice-president; Walter W. Ristow, secretary; and Lloyd D. Black, treasurer. Henry Madison Kendall continues as editor of the *Annals* and Shannon McCune as editor of *The Professional Geographer*. Northwestern University will be host at the 1951 meeting, to be held at the Palmer House in Chicago, March 19 to 22.

GEOGRAPHICAL REVIEWS

RAND McNALLY COSMOPOLITAN WORLD ATLAS. xvi and 335 pp.; maps, index. Rand McNally & Co., Chicago, New York, San Francisco, 1949. \$12.50. 14¼ x 11¼ inches.

GOODE'S SCHOOL ATLAS: Physical, Political, and Economic. By J. PAUL GOODE. Revised by EDWARD B. ESPENSHADE, JR. xvi and 286 pp.; maps, index. Rand McNally & Co., New York, Chicago, San Francisco, 1949. \$5.00. 11¼ x 9½ inches.

THE ADVANCED ATLAS OF MODERN GEOGRAPHY. By JOHN BARTHOLOMEW. New Series, First Edition. 108 and 47 (index) pp.; maps. Meiklejohn & Son Limited, London; McGraw-Hill Book Co. Inc., New York, 1950. \$6.00. 15 x 10 inches.

ATLAS DU XX^e SIÈCLE. By R. and M. OZOUF. 276 maps and plans on 71 plates, 600 ills. Fernand Nathan, Paris [1948]. 13¼ x 10¼ inches.

ATLANTE GEOGRAFICO ZANICHELLI AD USO DELLE SCUOLE. By GIUSEPPE NANGERONI and LEONARDO RICCI. 193 pp.; maps, index; with accompanying descriptive text, 160 pp. Nicola Zanichelli, Bologna, 1947. L.2200. 13½ x 9¼ inches.

SCHWEIZERISCHER MITTELSCHULATLAS. Mit Unterstützung durch den Bund und die Kantone herausgegeben von der Konferenz der Kantonalen Erziehungsdirektoren. 9th edit.: Jubiläumsausgabe 1898-1948. viii pp., 144 plates. Kantonaler Lehrmittelverlag, Zürich, 1947. Swiss francs 21.80. 13¾ x 9 inches.

ATLANTE GEOPOLITICO UNIVERSALE. By LUIGI VISINTIN. 210 plates, 593 pp. of text and index. Istituto Geografico De Agostini, Novara, 1947. 10¾ x 6¾ inches.

KOZENN ATLAS. Hergestellt im Geographischen Institut Ed. Hölzel. 71.-74. Auflage. 135 pp. Verlag Ed. Hölzel, Vienna, n.d. 11¾ x 8¾ inches.

Commercial atlases produced in the United States have long been inferior to the better atlases produced in Europe in design, selection of color, printing, and, not infrequently, accuracy. Perhaps this is due to inertia or lack of map education on the part of the American public, which has failed to create a demand sufficiently strong to justify the heavy expenses of an entirely new compilation. Whatever the reasons, this reviewer cannot believe that the general run of American atlases has reflected the best efforts of geographers, cartographers, and printers in the United States.

It is thus pleasing to note that Rand McNally's "Cosmopolitan World Atlas" is unquestionably the best general reference atlas that firm has produced to date and represents a distinct improvement in commercial atlas production in the United States. It is a general political reference atlas, without distribution maps of physical phenomena, population, trade, and so on. The type faces are legible, the colors pleasing. The use of blue drainage, coast lines, and grid increases the legibility. Relief is shown by brown hachures, which, however, are obscured in places by colors identifying political entities. If these overprinted colors had been restricted to broad bands along major boundaries and narrow bands of the same color along minor ones, as is done fairly consistently in Bartholomew's "Citizen's Atlas of the World," the brown relief hachuring would have been more effective; furthermore, minor civil division boundaries, which are shown in blue and are thus easily confused with drainage,

would have been clarified. Individual taste may lean to printing political maps with various flat color tints over the different political units, but where relief hachuring is also included, the varying colors from country to country cannot but detract from the overall legibility. The handling of hachures in the atlas is not always consistent; for example, they are included on maps covering North Africa (Pls. 38 and 39) but omitted on the companion map on the same scale for South Africa (Pl. 40). On some, but not all, of the maps hachures are drawn in perspective, block-diagram style.

Major emphasis is on the United States, though the precedence of foreign maps is a departure from previous practice. Each of the great land masses is shown as a whole, then in regions on larger scales. Europe, for example, appears as a unit on 1 : 16,000,000, with more detailed coverage on 1 : 8,000,000, 1 : 4,000,000, and, in certain areas, 1 : 2,000,000.

The two maps of the Polar Regions are out of date and below the standard of the majority. Unfortunately, too, there is generally poor coverage of the U.S.S.R. European Russia appears on 1 : 8,000,000; surely it would seem to deserve the same emphasis as other Central and Western European countries, which are given detail on twice that scale. The Union as a whole appears on the scale of 1 : 28,000,000 (1 inch to 442 statute miles). Aside from the small scale, the geography of Asiatic Russia does not reflect the use of the most modern source materials. Canadian provinces and individual states of the United States are given adequate coverage (from slightly larger than 1 : 1,000,000 to slightly smaller than 1 : 2,000,000 in most cases). In view of the size of Texas, this observer, though not a Texan, would vote for two pages for that state in a future edition.

The publishers proclaim the index complete, and rightfully so. More than half of the volume, 172 pages, is devoted to an alphabetical list of names; population figures are included. In addition, there are tables of world political, climatic, and economic data, as well as the more usual lists of distances, altitudes, and so on.

The format of the new (eighth) edition of Goode's School Atlas remains the same. The first 48 pages are new; 45 of them show world distribution of various physical and economic factors. A number of these maps—for example, that showing the production of wheat—employ the dot method, with accompanying bar graphs to show quantitative production in the major wheat-growing countries. The clarity of the new maps, the choice of colors, and the printing represent a marked improvement over the world maps in earlier editions. The main general reference maps seem to be reprinted from earlier plates with certain corrections, principally to accommodate recent political changes. Relief is shown by green and buff layer tints, bathymetry in shades of blue. This part of the atlas has been poorly reproduced and is in fact below the quality of the previous edition (see, for example, Pls. 65 and 102-103). This difference in quality of reproduction and printing of the reference maps was recognized by the editor in his preface and is to be remedied in a future edition.

Bartholomew's "Advanced Atlas of Modern Geography" is a small, well-executed product by a map-making firm of long years' standing and reputation. It is on the format of the same firm's "Oxford Advanced Atlas," 1942, with various world distribution maps preceding a reference series showing continents, then regions, on larger scales. Double-page maps permit much larger scales than those in the Cosmopolitan Atlas.

More study has been given to world map projection problems than in the other atlases under review here. A real attempt has been made to fit the projection to the purpose of the map, and the result is several revealing portrayals of world distributions. The best of these is

the "Nordic" projection, which appears to be an oblique version of the Aitoff centered at 45° N., 15° E. (Pls. 22 and 23). The resulting map is an excellent equal-area arrangement of the populated land masses which is comparatively free from distortion and which shows the Arctic Sea without interruption. This projection, independently developed by William Briesemeister at the American Geographical Society, was first used in the *Geographical Review* (Vol. 38, 1948, p. 616). A somewhat similar arrangement illustrated in "World Maps and Globes" (Fisher and Miller, 1944) results in tilting the Mollweide projection so that it is centered at 45° N. Bartholomew's "Atlantis" projection shows world airways well; it is a variant of the Mollweide, with the major axis a meridional great circle and the center of projection at 45° N. and 30° W. Incidentally, an important east-coast air route between North and South America is not properly shown. The "Recentered Sinusoidal" projection, so far as land distribution is concerned, is more effectively interrupted than Goode's version. The "Regional" projection is of the butterfly type with the North Pole as center. Here, though the shapes are excellent, the result is not wholly successful because of excessive interruption. It is used principally to show physical features by means of hypsometric tints.

All the general reference maps show relief by layer tints in both land and water areas. This system, common to European atlases, has not been generally adopted in the United States, Goode's atlas being an exception. The method not only gives a quantitative picture of true relief within the limits of scale generalization (a feature not possible with the hachure or perspective physiographic diagram method) but also permits a rapid comparison of relative altitudes in various parts of the map. Further, it does not detract from legibility as hachures often do if printed in strong colors. If, on the other hand, hachures are reproduced as a light underprint, they are apt to lose their character and have relatively little meaning.

The metric system has sensibly been adopted for the form lines, foot equivalents being noted in the legends, and linear scales are given in both kilometers and miles. For some of the European and United States maps economy probably dictated the use of contour plates of earlier editions, and in such cases it is rather surprising to note that the contours previously labeled in even hundreds and thousands of feet are now shown in even hundreds and thousands of meters. Thus a 6000-foot form line suddenly becomes a 2000-meter line—a difference of some 560 feet.

General and special interest coverage is superior to that of the Oxford Advanced Atlas, and the new maps have been recentered to include more geographically related areas. For example, the Levant coast (Pl. 76) is shown in good detail, and the map of the Balkans and the lower Danube (Pls. 58–59) now includes Crete, whereas in the earlier version the island appeared as a separate inset map. The map of the Caribbean (Pl. 97) seems to be an extension of the properly centered map of Mexico (Pl. 96). Considered as a separate map, it gives a curious skew effect to the meridians.

The index represents a new departure. A world-wide geographical coordinate system, referred to as "hour" coordinates, related to a world grid based on Greenwich, eliminates the confusion of reading east and west of the prime meridian. Spellings usually follow local official forms, but in the case of Brazil the official orthography has not been used.

The "Atlas du XX^e siècle" contains 71 clearly printed pages of maps, many of them folded, on physical, human, and economic geography. It has been designed for both teaching and general distribution. Many of the economic maps are based on the Atlas de France. Europe, Scandinavia and European Russia excepted, is depicted by both physical and political maps on the scale of 1 : 5,000,000, and locally on larger scales. Relief is shown by

conventional layer tints in green and brown combined with brown hachures to produce a somewhat plastic effect. Other continental areas are treated as combined physical-political maps, with less emphasis on detail. The Americas are shown on sectional maps ranging from 1 : 10,000,000 to 1 : 20,000,000, Africa and Asia on 1 : 10,000,000 to 1 : 25,000,000, and Australia and Oceania on a single map, 1 : 40,000,000. France, quite naturally, is emphasized, and of special note are eight sectional maps of that country on 1 : 1,750,000 on a geologic base. These maps show a wealth of place names and a communications pattern; relief is indicated by subdued hachures and prominent symbols locate places of economic importance. An unusual feature is a series of 600 photographs illustrating terrain and occupation printed in black and white on the reverse sides of the maps and supplementary to them. No index of names is bound with the volume.

Another atlas suitable for teaching and general reference use, the "Atlante geografico Zanichelli ad uso delle scuole," is notable for its beautifully printed series of town plans and a selection of maps showing settlement types and physical landscape (see, for example, facing-page maps of Genoa, Trieste, and Venice, 1 : 100,000, Pls. 3 and 4; settlement and landscape patterns, 1 : 50,000, Pls. 11 and 12; the Ruhr, 1 : 250,000, Pl. 52). Most of the maps are printed in pastel shades; relief is shown by green and brown layer tints, bathymetry in shades of blue. Special maps for Italy are also noteworthy for their rendition. Brown contour lines and blue drainage, with an overprint of soft green blending into yellow on the western and north-western ridge crests and violet hill shading, produce an excellent three-dimensional effect. Built-up urban areas and the surrounding settlement pattern are shown in black and white; railroads, with details of terminal yards, in reddish brown.

Another well-presented atlas is the "Schweizerischer Mittelschulatlant." Some of the plates are comparable in rendition to the hill-shaded series of the Zanichelli atlas. Tastes differ, it is true, but American map producers might do well to examine and consider certain plates in this Swiss school atlas; for instance, "Jungfraugruppe und Aletschgletscher" (1 : 100,000, Pl. 10); Asia "Vegetation" (1 : 60,000,000, Pl. 83); and "New York" (1 : 200,000, Pl. 117). It may be noted that a detailed review of this atlas, by Professor Nikolaus Creutzburg, appears in a recent number of *Petermanns Mitteilungen* (Vol. 94, 1950, pp. 169-176).

Among other recently produced world atlases, note should be taken of the "Atlante geopolitico universale" of the well-known Istituto Geografico De Agostini. This general reference volume, with colors over political areas and relief shown by brown hachuring, includes a 199-page, 4-column index of names. The "Kozenn Atlas," recently received at the American Geographical Society, is designed for school use. Its principal emphasis is on Europe; the United States is shown only on a scale of 1 : 20,000,000, and the largest scale for South America is a continent map on 1 : 40,000,000.

NORTH AUSTRALIAN REGIONAL SURVEY, 1946: Katherine-Darwin Region. (Advance copy.) By C. S. CHRISTIAN and G. A. STEWART. 150 pp.; map, diagrs. Melbourne, 1947. 8 x 13 inches.

This work is the first detailed study of any part of the northern fringe of Australia. The mimeographed edition here being reviewed was issued for advance circulation and revision. In the final printed edition two large maps and several photographs will be included. The contents of the report, presented in eleven parts with four appendixes, can be summarized under three main headings: physical conditions, past and present activities, and future possibilities.

After an introduction explaining the plan of study the climatic conditions are first examined. The only map in the publication shows the latitudinal differences in time of commencement of the rainy season and its duration. This is followed by a detailed description of various plant communities as they are related to other physical factors. A survey of the various land systems and soils in each district further explains the capabilities and limitations of the region. For each of the seventeen land systems of the district a very useful cross-section diagram is given, showing the relationships between topography, vegetation, soils, and geology.

The second part of the report consists of a review of plant and animal production in various parts of the district from the time of settlement to the present. Many types of crops, including grains, fiber plants, fruits, and vegetables, have been tried. Among the more successful are peanuts, some other legumes, broom corn, cassava, some tropical fruits, and vegetables. A survey of animal industries was made by type, location, and relative success of the undertaking. The animals considered include most commercial types raised in the United States and, in addition, the water buffalo, which seems best suited to this region.

On the basis of past and present activities in the region, future developments are considered. This careful study suggests certain possibilities for agriculture and grazing in particular districts and also reviews the limitations of the whole area. The government realizes that much more must be done in this district than the periodic surveys of the past and the five months of field work on which this report is based. Past demonstration and experimental farms on a "pay their way" basis have proved inadequate. To remedy this situation, the Council for Scientific and Industrial Research, which has been carrying on very effective work in other parts of the country, took over the army experiment farm at Katherine in 1946. This holding, favorably located in the district, has good communications with the outside and is expected to serve as a model for development in time to come.

The future of this region does not look bright because of physical handicaps, inability to compete successfully with other parts of the country, and living conditions less desirable than elsewhere.

This report presents new evidence of the present-day limitations of tropical savannas. To those teaching the geography of Australia it will be invaluable.—LYDA BELTHUIS

THE INVASION OF NEW ZEALAND BY PEOPLE, PLANTS AND ANIMALS:

THE SOUTH ISLAND. By ANDREW HILL CLARK. xiv and 465 pp.; maps, diagrs., ill., bibliogr., index. *Rutgers Univ. Studies in Geogr. No. 1.* Rutgers University Press. New Brunswick, 1949. \$6.00. 9¼ x 6¼ inches.

New Zealand, at the antipodes of Spain and France, is the most isolated habitable land of any considerable area—about that of the British Isles. It was the last such land to acquire human inhabitants, whether primitive or civilized. More remarkable is the fact that terrestrial mammals never reached New Zealand until transported there by man. The browsing and grazing pressure exerted in most parts of the world by rodents and ungulates was replaced in New Zealand by that of many species of large birds, which were wingless as well as flightless. Most of these became extinct, for reasons not yet fully comprehended, before the arrival of the first Pacific people. From such curious circumstances New Zealand may be said to have been "preadapted" for sheep.

A thousand years with even a sparse population of Polynesians undoubtedly produced changes in biotic balance, but they were negligible when compared with the profound alterations that began abruptly about the last decade of the eighteenth century. In the next 150 years the remaking of the landscape, in all districts readily available for timber or mineral exploitation, agriculture, or stock raising, has proceeded at a rate perhaps unequaled in any other temperate country. However useful or necessary these changes have been, many of them have degraded at an increasing tempo a wide variety of natural resources.

Professor Clark has lived as teacher and investigator at Christchurch. In his well-organized book he discusses the Europeanization of the South Island, the larger but less populous of the two main units of New Zealand, from aspects that include but also transcend mere "invasion" by alien organisms.

The South Island is about the size of Illinois, but the relief in relation to prevailing westerly winds produces astonishing extremes in precipitation. In Otago there are two stations 50 miles apart that, in 1940, had a difference of 367 inches in their total rainfalls for the year. Quasi-tropical rain forest on the western slopes adjoins large areas of grassland on the longer slopes east of the mountains. The grassland is now mainly sheep country. Much of it is overgrazed, seasonally burned, and depauperate because of the loss of nutritious native forage plants that once grew in a microclimate maintained by tall, sheltering tussock. Some of it is man-made desert. Impoverishment of vegetation has led in turn to a deranged water table, to evils of periodically rampaging rivers, and to erosion.

The trend from wilderness to present conditions has had a longer history than is generally recognized. Probably no earlier student has pointed out as clearly as Dr. Clark that settlement before 1840 had a notable effect on the development of the country. This is more or less contrary to the national attitude, in these present years of centenary celebrations, but it is nevertheless true. Hundreds of whites, including deserters from whaleships of many nations, inhabited the South Island during the early decades of the nineteenth century. They carried on extensive sealing and whaling and trade in flax (*Phormium*), timber, potatoes, and pork and disastrously depleted many resources. The native kahikatea or "white pine" of New Zealand was carried in quantity to Australia even before 1800.

Later, more substantial settlement depended, as did the great immigration to the United States, on contemporary hunger and misery in the British Isles, where wage earners numbering a quarter of a total town or city population were in some cases out of work. Between 1838 and 1842, 8000 British immigrants, nearly all from urban areas, reached New Zealand. Halving of hours of work per week and doubling of pay, as compared with the British regime, led to rapid economic betterment of the settlers. Nevertheless, much of the early occupation was relief or "made" labor, depending furthermore on reaping without sowing, as in the prompt felling and sawing of practically all the timber on the completely forested Banks Peninsula, in Canterbury. Real prosperity began only after the original agricultural aims gave way to stock raising.

The subsequent introduction of plants and animals that made the South Island an astonishing center of acclimatization was due to the desire of the settlers to make New Zealand like "home." It is not widely realized that acclimatization societies also existed in practically every city and town of the United States during the latter half of the nineteenth century, and that countless European birds, other animals, and plants were brought to this continent. Most of the animal organisms did not "take" because the ecological niches here

were already filled, but in isolated New Zealand, with its restricted avifauna and complete lack of mammals, they took hold with unparalleled vengeance. Most of the landscape outside the forest now bears the silva of California, Europe, or Australia, particularly in homesteads, shelter belts, and hedgerows. Both open land and forest harbor introduced pests, the astronomical number of which can be judged only by considering examples of the fractional annual toll (20,000,000 rabbit pelts were exported in 1925). Deer and related ungulates of 10 or 12 species, chamois above tree line in the mountains, wallabies from Australia, hedgehogs, carnivorous mustelids such as weasels and stoats, and a horde of foreign birds have combined, in ways both direct and subtle, to upset the original balance and to pose problems of which only a small proportion of New Zealanders are yet sufficiently aware. The destruction by deer of seedlings, and hence of forest replacement, in woodlands that developed through millions of years in the absence of mammals is an example of the slowly but inexorably growing threat to New Zealand's future.

Dr. Clark does not attempt to point the way out of New Zealand's socioeconomic difficulties, but it is a sufficient service that he has so plainly described the present conditions and the antecedents that have led to them.—ROBERT CUSHMAN MURPHY

RICE CULTURE IN TAIWAN. By N. B. MENDIOLA. Map, diagrs., ills., bibliogr. *Philippine Journ. of Agric.*, Vol. 14, 1949, pp. 41-83.

POSTWAR ECONOMY OF TAIWAN, A CRUCIAL AREA OF EAST ASIA. By ARTHUR A. SIMPSON. Ills. *Foreign Commerce Weekly*, Vol. 37, No. 11, 1949, pp. 3-5 and 40-43.

L'ILE DE FORMOSE. 14 pp.; map. *La Documentation Française*, No. 1189, Sept. 1, 1949.

FORMOSA. *Übersee-Rundschau*, Hamburg, 1950, No. 1, pp. 14-15.

POOR LITTLE RICH LAND—FORMOSA. By FREDERICK G. VOSBURGH. Map, ills. *Nat. Geogr. Mag.*, Vol. 97, 1950, pp. 139-176.

Not until World War II did the Pacific island of Taiwan assume any importance in international wars. Not since the bandit-patriot Koxinga defied the mighty Manchu conquerors of China from this pirates' nest during the latter part of the Ming dynasty has Taiwan been of first importance in the politics of China. To the world in general and to Americans in particular, Taiwan, or Formosa, "the island beautiful," as the Portuguese called it, was interesting merely as the source of about 85 per cent of the world's natural camphor and the producer of fine oolong tea. To the Japanese who wrested the island from China as the prize of the Sino-Japanese war of 1894-1895, the tropical climate made up for Japan's lack of sugar production and furnished a great variety of tropical fruits as well as considerable additions to their rice supply. Today, its strategic position athwart the major trade route less than 200 miles from the China mainland gives it aerial and naval command over ports and coastal shipping from Shanghai to Canton in the Nationalist-Communist struggle. The Korean war, furthermore, has sharpened vital United States interest in preserving from Communist control this anchor stone in the Asiatic-Pacific chain of islands screening the continent of Asia. It is not surprising, therefore, to find several articles of geographical interest recently focused on this small piece of land in the Western Pacific.

Of the five articles here reviewed, the first is a systematic and extremely detailed technical study of rice culture as practiced in Japanese Taiwan before the end of World War II.

The article in the *Foreign Commerce Weekly* is paralleled by the somewhat more systematic and all-inclusive study in *La Documentation Française*, which gives an overall account of Taiwan's culture and economy. The shorter note in the *Übersee-Rundschau* seems to have been translated directly from the *Foreign Commerce Weekly* and abbreviated. Even the order of arrangement of subject matter and statistical material is the same. The last article is the pictorial account in the *National Geographic Magazine*, a chatty, personalized traveler's account that covers the neighborhood gossip of Taiwan and provides a smattering of official statistics and some analytical comments. Information ranges from the 86,000 yuan paid for a postage stamp to the official population count of 7,026,883 for 1949. The reader is told why the Taiwanese hate the Nationalist government and also how the destructive dual-sexed African garden slug (*Achatina fulica*) furnishes the Taiyal tribesman his luncheon morsel.

Next best to firsthand observation of a foreign land are well-focused photographs of the variety that combine to make up a cross section of its culture. Photographer J. Baylor Roberts has done a superlative job in the *National Geographic* tradition for excellent pictures. The natural emphasis on the picturesque non-Chinese aboriginal tribespeople may mislead the uninformed reader as to the relative importance of the tribal culture in Taiwan, where the total number of non-Chinese tribal people is estimated at only 200,000, as compared with the Chinese population of almost 7,000,000. Of special interest to the geographer is the descriptive account of the road and rail trip round the island, though Vosburgh did not make the most of his opportunity to give as comprehensive an account as he might have done.

La Documentation Française begins its short study of Formosa with a brief historical summary, a description of the physical geography (which the other articles do not attempt), and an account of the population and political administration (as of outdated Japanese times) before launching into a discussion of various aspects of the economy. Much of the information is confined to the prewar situation. Thus the statistics are in large part limited to pre-1937 figures, and there was evidently a heavy dependence on the *Japan Yearbook* of 1941. Although it is not as up-to-date in some of its information as the *Foreign Commerce Weekly*, a greater variety of industries is included. Also, it does well what the *Commerce* article fails to do: it supplies the names of places and areas of production or specialization. The *Commerce* article, however, is more analytical and less purely descriptive.

Foreign Commerce Weekly agrees with *La Documentation Française* in finding that technically and in equipment Taiwan, though still mainly agricultural, is relatively more modern than mainland China. From its cultivated 23.85 per cent of the total area it not only has gained self-sufficiency in basic foodstuffs but can export a surplus of rice, sugar, sweet potatoes, vegetables, fruits, camphor, tea, and essential oils. However, because of shortages of chemical fertilizers, on which the agricultural economy is much dependent, postwar yields and production in many crops have dropped greatly. It is surprising to find that during the 1930's Taiwan was the third-largest producer of canned pineapple in the world. Production, which in 1939 amounted to 145,816 metric tons, had been reduced by 1946 to 17,265 tons. Fertilizer costs have increased far out of proportion to the value of agricultural products in spite of ECA efforts to help. This situation has adversely affected the foreign markets for Taiwan products.

In spite of Taiwan's advance technically over mainland China, Taiwan industry is not far advanced. More than 70 per cent of it deals with foodstuffs, and nearly 10 per cent with chemical fertilizers. The Nationalist government has taken over most of the industries, which were largely Japanesed-owned. It has organized into huge combinations the many

single units of like industries and, together with the provincial governments of the island, has virtually complete domination of the economy. Taiwan has an annual export surplus of more than a million tons of coal and also has crude-oil refining capacity greater than the island needs, but deteriorated plant and equipment make costs such that prices are not competitive on the world market.

Nevertheless, fragmentary postwar data indicate a continuation of the prewar favorable balance of trade. High costs limit trade with Southeast Asia, and, with the continent cut off, it seems that Taiwan at present, as before, must look to Japan for the marketing of most of its exportable surpluses.

Students of rice culture should find much of interest in Mendiola's study of how Japanese rice experts succeeded in raising the yields and quality of Taiwan paddy. Although Philippine sugar-cane yields are said to be superior to those of Taiwan, the rice yields per hectare in Taiwan in 1940 were double those in the Philippines. The study is based on statistics supplied by official agricultural sources in Taiwan and on the author's tour of observation in Taiwan in 1944. All aspects of rice culture are described in detail, including the methods used by Japanese experimental stations in selection and improvement of rice strains. Various tables of statistics are presented, but their treatment is confusing. In describing the effect of the climate on rice culture, the author points out the difference between the wet northwest and the southwest, where distinct wet and dry seasons occur. Wind damage is such a factor (chiefly as it affects pollination) that in Tainan district alone some 4000 kilometers of wind-break in the form of bamboo growth have been established. Hormone applications were found by the experimental stations to increase yields from 10 to 20 per cent. Another finding was that seeds of some plants, including rice, grown at a higher level have a larger yield than those grown at a lower level. The increased rice yield is partly attributable to the introduction of the Horai strain of Japanese rice, which has less hull weight per unit of paddy. Seed selection within native Taiwan strains of rice also has increased yields by 10 to 30 per cent. The failure in early attempts to introduce Japanese strains of rice was caused by their too early maturity in the climate of Taiwan, which resulted in leaner kernels.

The author does not make recommendations for changes in the Philippine rice culture based on his observations in Formosa. The reader recognizes the features apparently responsible for the success of rice culture in Taiwan, but he is not shown "which of these methods could be adopted and could be introduced, immediately if possible, into the Philippine rice farming, in order to increase production and yield."—HEROLD J. WIENS

ANTIOQUEÑO COLONIZATION IN WESTERN COLOMBIA. By JAMES J. PARSONS. viii and 212 pp.; maps, diagr., ills., bibliogr. *Ibero-Americana No. 32*. University of California Press, Berkeley and Los Angeles, 1949.

In this monograph the author gives an excellent description of the characteristics of the Antioqueño people and the nature and progress of their remarkable geographical expansion that followed their transition from a mining to an agricultural economy at the end of the colonial period. This internal colonization of the nineteenth and twentieth centuries is summarized in an excellent sketch map showing the movement out of the old core area of settlement in the auriferous crystalline highlands around Medellín southward onto the temperate middle slopes of the Cordillera Central and the Cordillera Occidental. The colonists' avoidance of both the warm valley of the Río Cauca and the high, cold uplands

of the Central Cordillera in favor of the *tierra templada* represents an interesting adjustment to geographical conditions, in themselves purely climatic. The climatic *minifundismo* of these Andean lands of extremely broken topography is little understood, but each valley and slope has its characteristic climate, in considerable measure a product of local topography. Available meteorological observations, some of which are cited by the author, are admittedly extremely unreliable and represent only gross approximations. Because of the significance of the vertical temperature gradient, I believe it should be an unbreakable rule to draw no sketch map or geographical map of Colombia without contours. By following this rule the unusual spatial characteristics of Antioqueño colonization would have been more effectively presented, notwithstanding the fact that the author explains them very well in the text. Nowhere has this *cultura de la vertiente* been so well developed as in Luís López de Mesa's famous "Emancipación del Trópico," and it is surprising that this outstanding Colombian intellectual figure, an Antioqueño, does not appear in the author's otherwise satisfactory bibliography.

As the author has well noted, the Antioqueños' penetration into the rich volcanic-ash soils of the Quindío after 1880 was their most brilliant conquest. From this famed coffee-growing district they have spread southward along the slopes overlooking the level floor of the Valle del Cauca, the most promising region for future development in western Colombia, whose valley floor has only recently attracted Antioqueño settlers. Two distinct groups are carrying the Antioqueño expansion into other departments. One is the agriculturist, who is well known; the second and more recent is the capitalist, who has extended much farther—as far as Cali and Popayán in the south and Montería and Loricá in the north. The Antioqueño farmer seems eventually to follow the capitalist. He is found today on the slopes of the Farallones de Cali, in the Sabanas de Bolívar, along the Golfo de Urabá, in the forests of the Carare, and even in the Sierra Nevada de Santa Marta.

There are chapters on the physical geography, the indigenous population, colonial mining, transportation routes, and the relationship of government land policies to settlement on empty, state-owned lands (*balíos*). There is an extensive discussion of economic plants, but the carefully made graph of their vertical distribution does not go high enough to show the upper limit of potato growing in the Department of Caldas, where this crop plays an important role in the economy. The upper economic limit of coffee hardly passes 1800 meters here, though the author shows it as higher. The discussion of the influence of the seasonal distribution of rainfall on coffee cultivation is of special interest.

The chapter on transportation is largely concerned with historical development and very little with the present situation. In Colombia today there is an extraordinary development of aviation, probably at the expense of ground communications, which is favoring concentration at a few focal points such as Medellín. The airplane conquers the distance between two points but not the space which separates them.

The industrial development of the Valley of Medellín is described as a product of Antioqueño vigor and energy together with the relative poverty of the soils of the Department of Antioquia. The large textile mills, dependent chiefly on imported raw materials, employ mostly young girls, who are counseled and watched over by religious communities. It is unfortunate that the author does not go more deeply into the relationship between modern industrial capitalism and the Catholic Church, for this is an important sociological factor in tropical America. The headlong growth of Medellín and the consequent inade-

quacies of public services are well described. In the chapter on population growth the author writes with clarity of the precarious social, economic, and hygienic conditions that are the products of this rapid industrialization and their unfavorable impact on the biological development of the population. It would have been worth while here to make a comparative study of Medellín and other Colombian cities, such as, for example, Cali, which has an immense hinterland and a future potential as yet unknown, whereas Medellín, with its restricted valley, has a limited future, for precisely the same geographical reasons that produced the characteristics of the Antioqueños.

The author has seen and described the people and their environment with great sympathy, almost like an Antioqueño, and thus, perhaps, not without bias. The graphic material is excellent and would have been complete if the general orientation map had included the communications network. In résumé, this book, a product of much scholarly research, is the best study on the Antioquia region since Manuel Uribe Ángel's "Geografía y compendio histórico del Estado de Antioquia," published more than 65 years ago. Significantly, a Spanish translation by Emilio Robledo is being published by the departmental government in Medellín.—ERNESTO GUHL

PUERTO RICO'S ECONOMIC FUTURE: A Study in Planned Development. By HARVEY S. PERLOFF. xviii and 435 pp.; diagrs., ill., bibliogr., index. The University of Chicago Press, Chicago, 1950. \$4.75. 9¾ x 6¾ inches.

INDUSTRIAL DEVELOPMENT OF PUERTO RICO AND THE VIRGIN ISLANDS OF THE UNITED STATES: Report of the United States Section, Caribbean Commission, July 1948. By THOMAS HIBBEN and RAFAEL PICO. xx, 268, and 32 pp.; ill. \$1.50 (obtainable from International Documents Service, Columbia University Press, New York). 9¼ x 6¼ inches.

A SOCIO-ECONOMIC STUDY OF SOUTHWESTERN PUERTO RICO. By MARTÍN HERNÁNDEZ-RAMÍREZ. Maps. *Univ. of Puerto Rico Journ. of Agric.*, Vol. 31, No. 1, 1947.

INDUSTRIAL DEVELOPMENT IN PUERTO RICO. By W. ARTHUR LEWIS. *Caribbean Econ. Rev.*, Vol. 1, 1949, pp. 153-176.

Administrators, scientists, and technicians can learn a great deal from Puerto Rico. As they prepare to unravel the tangled skeins of economic, political, and sociological problems in the underdeveloped areas, they can profitably examine errors and achievements in our most populous remaining colony. They will find a complex in which geographic factors, haphazard colonial policies, vested imperial interests, vestigial remains of feudalism and obscurantism, high-powered corruption, and absence of incentives left a people poverty-stricken and almost hopeless. Since about two-thirds of the people of the world live in similar conditions, it is important to understand just what steps were taken to mobilize the people and resources of Puerto Rico for "the battle of production" that is now taking place on the island. It is also imperative to know what problems arose. All these publications help in this endeavor.

Perloff's study is a highly successful broad-gauged attempt to deal with the whole economy, with emphasis on those factors which must be brought under conscious control if levels of living are to be raised. The resources of the island, both inanimate and human, are examined. The debit and credit sides of the close ties to the economy of the United

States are weighed. Seven short chapters on "principles and programs of planned economic development" summarize and analyze the insular experience. The major planning and operating instrumentalities are described, critically wherever it appears necessary. The list of nine "essential elements of an industrialization program" (pp. 376-377) contains the distilled experience of the island in this field.

Exceptionally important is Perloff's courageous treatment of the population problem. The United States has been responsible for the introduction of techniques of applying intelligence to the control of deaths; powerful groups on the continent as well as local physical and cultural difficulties have hampered the application of intelligence to the control of births. The result has been a doubling of the population in the past 50 years and a forecast of about 4,000,000 by 1980. The population density in 1950 is 643 to a square mile, about 13 times that of the continental United States. Perloff's two chapters "The Nature of the Population Problem in Puerto Rico" and "Problems and Techniques of Population Control" are outstanding in modern economic literature.

The Caribbean Commission report confines itself to industry and gives many more details on individual industries and products; there is comparatively little analysis. Those interested in a particular industry will find the report a valuable supplement to Perloff. A short section is devoted to Puerto Rico's eastern neighbor, the Virgin Islands, once described by Herbert Hoover as the "poorhouse of the United States," whose people have also been attempting to work toward a better future.

The socioeconomic survey is a detailed examination of an area of about 100,000 acres, containing about 43,000 persons, largely dependent on sugar cane. It is a fine example of the manner in which planned programs are based on careful study and analysis. The chief problems presented to Hernández-Ramírez revolved around land tenure and the possibilities of raising production and productivity through irrigation. The result is a most enlightening contribution to the discussion of optimum farm size. That the author is now assistant commissioner of agriculture is an earnest of the progress being made in conquering the old Spanish traditions of nepotism and favoritism and filling technical jobs with technicians. A crucial factor not analyzed is the effect of the United States sugar quota on the redevelopment of the area.

Professor Lewis not only summarizes the main features of the industrialization program but devotes most of his scanty space to analytical comments. His predecessors at Manchester University, where he teaches economics, would find some of his ideas shocking; modern students striving to solve the multitudinous problems of the "backward" areas will benefit from his knowledge and keen mind.—CLARENCE SENIOR

THE SOCIALIZED AGRICULTURE OF THE USSR: Plans and Performance. By NAUM JASNY. xv and 837 pp.; maps, diagrs., bibliogr., index. *Food Research Inst. Grain Economic Ser. No. 5.* Stanford University Press, Stanford, Calif., 1949. \$7.50. 9¼ x 6 inches.

Although it is not geographically oriented, the geographer will find in this book much material for an understanding of the agricultural landscape of the U.S.S.R. He will do well to start with Part II, "Background," which treats of the elements of the natural environment and their role in setting limits to crop and livestock distribution and the complex of cultural factors that combine to determine the manner and extent of their utilization. The severe physical limitations of cold and aridity, for instance, are set against the pressure of

population. Russian resources considered in relation to a large, growing population and to total area, present a pattern considerably less grand than Soviet information would have us believe. In the cultural complex, inherited tradition and the stages of technology before and after the revolution have their part. Systems of land tenure, means of producing and disposing of agricultural products, living standards, and conditions before the collectivization of agriculture between 1928 and 1933 are discussed.

Areal distributions of crops and livestock are considered in Part IV, "Socialized Production: Plans and Results," with chapters on individual products, their acreage, yield, and utilization. The importance of cereals cultivation to the Russian people is emphasized, and shifts in the production of bread crops are analyzed, particularly the expansion of wheat acreage into the non-chernozem areas.

Probably the most important single contribution of this work is the critical analysis of the methods used in growing the crops and producing the stock. The author concludes that the chosen Soviet method of replacing the backward peasant farming system with state and collective farms has not proved its vaunted superiority. The evidence, based on performance and achievement, would suggest that the organization of these farms did not result in the wisest use of the available land or adequate recognition of labor and capital potential. In Part I, "A Summary View," and Part III, "Socialized Organization and Control," the question of methods and the intensity of application to the land of labor, capital, and organization, as well as the return of products, is presented in considerable detail. Comparison of the American and Russian systems indicates that a higher degree of intensive application is achieved in the U.S.S.R. However, the number of hours in a year that machinery is operated is hardly evidence of the superiority of socialized agriculture; rather, it suggests poverty, for the United States leaves its machinery idle in the attainment of high productivity per man, which is estimated to be about four and a half times that of the worker in the Soviet Union.

The concept that production maintains a steady upward spiral in proportion to the amount of machinery employed is dispelled by the author's treatment of "Mechanization" and "Techniques Other Than Mechanization." Russian reverence for the machine has resulted in the application of mechanized techniques where conditioning elements of farm size, terrain, climatic controls, and the value of resulting products are either inadequately considered or completely overlooked. Save to secure to the government its share of the agricultural output, on a "cost-accounting" basis mechanization as practiced in the Soviet Union is considered largely unprofitable even in areas suited to its use.

Part V treats of "Over-all Production and Income." It is not easy to classify the Russian agricultural worker in terms of the Western world. "Commercial" or "subsistence" farmers do not exist in the strict sense, despite a temptation to alter the definition to fit the particular circumstance. Russian "farmers" as indicated are on the whole paid laborers in agricultural industry, whether on government payrolls or participating in distribution of income for collective effort on the large farms. The intention of the farmer plays a large part in the production and distribution of agricultural products in the Western world, but practically none in the planned society of the Soviet state. This influence on the pattern of distribution has served in the past as a general geographic indicator of division between the Occidental world's progressive agriculture and that of peoples little affected by the Western world's way of life. Russia's adoption of Western mechanized techniques and her rejection

of this influence in the operation of an industrialized agricultural structure suggest the need for an adjustment of criteria for geographic classification of her agricultural economy.

Farm organization, the structures that house and facilitate farming operations, and the pattern of collective life may be assembled from material in the author's discussion of the *sovkhozy* (state farms) and *kolkhozy* (collective farms). Maps on soils, precipitation, and natural and political divisions are contained in the chapter on natural resources, and numerous tables and charts are distributed through the book. Technical data pertinent to generalizations made in the text are grouped together in the appendix.

The effect of this excellent and comprehensive survey is somewhat obscured by vociferated opinion and the economic rationalizations stemming therefrom. Definitive evaluations of Soviet policy, performance, and achievements distributed throughout the study are subject to error through methodological subjectivity and bias, such as conclusions drawn from "implied" or "clearly suggestive" material as a means of improving the obviously questionable character of much of the original data from the U.S.S.R. The whole of the work is necessarily conditioned by the severe limitation of reliable data from Russian and other sources—a problem irritatingly familiar to workers in the Russian field. It is well to keep in mind an apparent intellectual bent in judging the reliability of interpretations and methods used in arriving at "probable" conclusions. However, this is not to deny Mr. Jasny a heavy vote of appreciation for his prodigious labor in canvassing the pertinent literature and his attempt to relate Russian statistics and information to the facts.—ALBERT E. BURKE

AMERICAN BARLEY PRODUCTION: A Study in Agricultural Geography. By JOHN C. WEAVER. ii and 115 pp.; maps. Burgess Publishing Co., Minneapolis, Minn., 1950. \$3.00. 11 $\frac{1}{4}$ x 8 $\frac{1}{2}$ inches.

This is a pleasing and handy volume for anyone interested in learning something of the "why" and "wherefore" of past and present barley production in the United States. It not only discusses the effect of ecological factors on the geographic pattern of barley production, but it also touches on the influence of economic, social, and political trends.

An outstanding feature is the series of dot maps prepared from census data to show the distribution of the barley crop by decades from 1839 to 1919, by five-year periods from 1919 to 1939, and for each year and by counties in the North Central States beginning in 1939. Lines of climatic resistance and regions of barley production in the United States also are shown, but most of the 51 maps illustrate some aspect of production—acreage or yield. A considerable part of the text is a discussion of the data carried by the maps. Major shifts in production areas over the years are explained, and considerable space is given to a review of the production pattern in the North Central States for the present decade.

An introductory section reviews the origin and ancient records of barley cultivation. It is followed by a short account of the introduction and early development of the grain in the American colonies. Then comes a discussion of the ecological factors related to the modern distributional patterns of barley in the United States—climatic limitations, the great soil groups and soil types and their relative suitability to the grain, plant diseases, insect pests and competitive field weeds. One statement might be better phrased: "The soils must not be acid, although barley will successfully withstand moderate concentrations of alkali. The most satisfactory yields are obtained from soils with a nearly neutral or slightly alkaline reaction." This is neither entirely correct nor consistent.—KENNETH ABLEITER

EAST AFRICAN AGRICULTURE: A Short Survey of the Agriculture of Kenya, Uganda, Tanganyika, and Zanzibar, and of Its Principal Products. Edited by J. K. MATHESON and E. W. BOVILL. xvi and 332 pp.; maps, ills., bibliogrs., index. Oxford University Press, London, 1950. 25s. 8½ x 5½ inches.

The romantic and intricate story of agriculture in East Africa is told for the first time in this volume, which contains chapters by the editors and 25 specialists. The practical emphasis reflects the working philosophy of Bovill, Matheson & Co., Ltd., a firm intimately associated with agriculture in East Africa. As part of this empirical approach, particular attention is given to the importance of research and experimentation in soils, crops, breeding, labor organizations, and export marketing.

General geography, land tenure, white settlement, native labor and welfare, soil conservation, and the existing agricultural research stations are dealt with in the first part of the book. Then follow, for individual livestock, sections on the history, present methods of production, with detailed accounts of expenses in some cases, and the final marketing of the product. Thorough discussions are presented of corn, wheat, dairying, sheep, sisal, sugar, tea, and coffee, as well as of less common products such as pyrethrum (of which Kenya produces the best grade in the world), geranium oil, lavender oil, papain, passion fruit, black wattle, and simsim.

A dominant theme, making fascinating reading, is the history of European agriculture in its struggles to find the right crops for local conditions. Here the editors draw on Elspeth Huxley's able biography of Kenya's great settler, Lord Delamere (Elspeth Huxley: *White Man's Country*, 2 vols., London, 1935). The corollary problem of transportation over an expensive railway and long ocean distances to compete in established world markets has required as much thought and ingenuity by those who have overcome it (among them Bovill and Matheson) as it has work and sacrifice by pioneering farmers. Discussions of agricultural exports and their relation to the world market include such matters as the arrival of Kenya lambs at the London market just when New Zealand and Australian supplies are lowest; competition in American markets between lavender oil from Kenya and that from the standard source in the French Maritime Alps; and the beginnings of the much-attacked groundnuts (and sunflower) scheme to ameliorate the world shortage of fats. In one sense the book is only a preliminary account, for rapid change and overnight development of new agricultural practices are still the keynote in Kenya; since the book was written, a cannery to pack fruits and vegetables for export has been started.

European agriculture receives the most detailed coverage, which accounts for an emphasis on Kenya, but there are adequate surveys of the agriculture of other parts of East Africa.

Statements such as "Few East Africans become skilled craftsmen . . . chiefly due to racial failing" and "The native is naturally careless and lacks powers of concentration" or that the admittedly poorly trained African teachers on estate schools manage "to amuse their pupils much as a monkey at a zoo" will grate hard on the ears of many. Despite such unfortunate phrasing, the editors in their general statements and in the ideas they have put into effect in their own business enterprises show an enlightened attitude toward the solution of the racial problems closely interrelated with profitable large-scale agriculture in East Africa.

Excellent photographs of major crops and the means of processing them; appendixes

giving statistics on such matters as climate, population, exports, and workers' diets; and tables of weights and measures add to the book's value. The last are useful in explaining such units as the ubiquitous *debe*, the gasoline tin holding four imperial gallons used for head carrying, packing, and shipping throughout East Africa. Also included is the best (although 15 years old) population map of East Africa and three colored Phillips' maps of the region, the selection and quality of which are far below the general level of excellence. There is no map dealing with crop distributions, and the map showing roads omits the highways from Kampala to Entebbe and from Kampala to Masaka, two of the three most important and most heavily traveled roads in the whole Uganda Protectorate.

In their preface Bovill and Matheson describe the need for a detailed and documented book on their subject and express their aim as "filling the interim with a modest volume that will satisfy the bare needs of those requiring an introduction to East African agriculture." They need not have been so modest, for it will probably be accepted as the standard work for some years to come. Geographers, whether they are concerned with agriculture on a world-wide systematic basis or with the continent of Africa through a regional approach, will find this contribution of real worth.—EDWIN S. MUNGER

CLIMATE THROUGH THE AGES: A Study of the Climatic Factors and Their Variations. By C. E. P. BROOKS. 2nd edit. 395 pp.; maps, diagrs., bibliogrs., index. Ernest Benn Limited, London; McGraw-Hill Book Co., New York and Toronto, 1949. 21s.; \$4.50. 8¾ x 5½ inches

The first edition of this well-known study of climatic change (1926) achieved a reputation as a leading reference work in its field. Its author, Dr. C. E. P. Brooks, former senior climatologist in the British Meteorological Office, has marked his retirement by publishing an extensively revised second edition. Like its predecessor, it must have a place on every geographer's bookshelves.

The plan of the book has been preserved intact, though several of the chapters have been entirely rewritten. Part I deals with the various elements of climate and the extent of their variations. Brooks attempts to find quantitative measures of the effect of change in one element on another. Particularly valuable is his review of the normal climate of non-glacial periods in the past. His examination of the equilibrium of an icecap under changing temperatures comes through with little change from the first edition, as does his review of the continentality factor. Both are founded on too simple a set of assumptions to yield readily to criticism.

Part II discusses the climates of the geological past, with particular reference to the Permocarboniferous and Pleistocene glaciations. Great stress is laid on the theory of continental drift, and a careful examination of the climatic evidence for (and, even more, against) the Wegener-Köppen reconstruction of past climates in terms of drift seems now to lead the author to a hostile verdict. Part III includes a review of the climatic fluctuations of the historical period. Since Brooks wrote, H. W. Ahlmann has published several brilliant reviews of this latest aspect of climatic change. It is unfortunate that the book contains no reference to Ahlmann's syntheses; his papers have touched off a vigorous rediscussion of the entire field.

"Climate through the Ages" does not set out to be a primer of climatic change: the reader will look in vain for details of how pollen spectra are prepared and analyzed, or why

varve dating has enjoyed so wide a vogue among geologists. The book is in essence an interpretation of the existing evidence in the light of sound meteorological theory, and as such it has no rivals in the English tongue. The author is in the position of the uniformitarian geologists of the nineteenth century: he argues that past climates must be explained in terms of physical laws that are observable in the modern world. He rejects the catastrophic and *ad hoc*, pointing out that such premises usually lead to meteorological absurdities.

One can criticize details. Brooks sometimes allows his climatological pen to outrun the reader's experience. Thus to talk of the "Iberian anticyclone" and the "North American winter anticyclone" is to convey to the general reader that permanent high pressure sits upon these regions. All the author means, of course, is that high pressure occurs on the mean pressure map; but he is wrong in assuming that this limitation will be obvious to the nonclimatologist. In other ways his style is attractive, his writing simple and unpretentious. Speaking, for instance of periods that have been termed "pliothermal," he says: "I prefer the simpler word 'warm,' which means the same." One could wish that Dr. Brooks's humility were more often encountered.—F. KENNETH HARE

METEOROLOGY OF AIRFIELDS. By C. S. DURST. 87 pp.; maps, diagrs., bibliogr., *Gt. Brit. Meteorol. Office [Publ. No.] 507*. His Majesty's Stationery Office, London, 1949. 2s. od. 9½ x 6 inches.

Mr. Charles Durst is assistant director of the Meteorological Office (Air Ministry) in charge of investigations. Throughout the past war, and for many years before it, he was engaged in the useful business of applying meteorology and climatology to the needs of aviation and military operations. He has now given us a condensed summary of his views on the effects of weather on airfield construction, operation, and maintenance. His long experience, together with the inexhaustible statistics to which he had access in preparing this monograph, makes it of outstanding interest to all concerned with air transportation; it will not be quickly replaced.

The first two-thirds of the study consist of a review of the effect of visibility, cloud, precipitation, wind, pressure, and temperature on airfield serviceability. Each section is supported by tabulated statistics drawn from airfields in Europe, Africa, Asia, and Australia, with North America running a poor fifth. The meteorological background of each form of adverse weather is fully explored, and means of minimizing delays and dangers discussed. Inevitably one can select omissions. Why, for example, is there no mention of that prevailing nuisance of the Canadian winter, blowing snow? And are not the turbulent wind changes of a cold frontal passage—not specially discussed—one of the worst landing hazards of a Middle Western airfield? But such omissions are few and trifling, and the reviewer must reiterate the astonishing catholicity of Mr. Durst's knowledge.

The book ends with long statistical appendixes giving cloud height and visibility frequencies from a wide range of airfields from every continent.—F. KENNETH HARE

WEBSTER'S GEOGRAPHICAL DICTIONARY: A Dictionary of Names of Places with Geographical and Historical Information and Pronunciations. xxxi and 1293 pp.; maps. G. C. Merriam Co., Springfield, Mass., 1949. \$8.50. 10 x 6¾ inches.

Among the most valuable aids to geographical research are the encyclopedic reference works usually called "gazetteers" or "geographical dictionaries." These works, which are intended

to fill the needs not only of the geographer but also of the general public, normally provide concise information (in alphabetical order) concerning specific geographical places, regions, physical features, and the like. Strange as it may seem, geographers have been forced to rely during the past 50 years on classic but antiquated works, such as the Lippincott Gazetteer (1906) and Longman's Gazetteer (1902), for no gazetteers of similar elaborateness have been published in English during recent decades.

Although it is of smaller scope than the traditional gazetteers, the Merriam-Webster dictionary fills a great gap in the field of geographical publications. This single handy volume has been published in a format and typography similar to those of the Webster New Collegiate and Biographical Dictionaries. The main, alphabetical part of the book is preceded by some useful introductory matter familiar to regular users of the Webster dictionaries. This includes explanatory notes concerning the general arrangement of entries and cross references (which play an important part in a reference work of this type); a guide to pronunciation, with a key to the Merriam-Webster pronunciation symbols and a description of the sounds they represent; a list of abbreviations and symbols used in the text, tables, and maps; a useful glossary of foreign geographical terms; and a brief discussion of map projections, illustrated by two maps of the world on the Mercator and polar azimuthal equidistant projections. The map material of the dictionary includes also more than 150 black-and-white maps scattered through the alphabetical section and 24 colored historical and general maps in a separate section at the end of the book.

The main, alphabetical section of the book is printed in large readable type, with the headings in boldface. Most of the important country and state entries are accompanied not only by a map but also by a table listing the administrative divisions, their location, area, population, and capital. These concise tables, and others on such matters as the ranges of the Alps or the dams of the Tennessee Valley Authority, are one of the most useful features of the work and are preferable by far to any alphabetical scattering of the tabulated material throughout.

The minimum population figures used in the selection of cities, towns, and villages offer an idea of the scope of the book. Although emphasis has been placed on the United States and Canada, where all incorporated places with a population of more than 1500 have been included, foreign countries are also well represented. The minimum population criteria range from 5000 for the British Isles and Australia to 25,000 for the U.S.S.R. and China. In addition to places entered on the basis of population, a great number have been selected because of historical or other special interest.

Spot checking reveals generally high standards of accuracy and up-to-dateness, two criteria by which reference works of this type are usually evaluated. Facts pertaining to World Wars I and II are particularly well chronicled under the pertinent headings. The reader will find such entries as Omaha Beach, Ledo Road, Fort Eben Emael, and Henderson Field, names that owe their fame to the recent war.

Unfortunately, postwar changes are not always equally well covered. In Europe some geographical names have been treated in accordance with the territorial transfers. Thus Russian names head the entries in areas (Western Belorussia, Western Ukraine) that were transferred from Poland to the U.S.S.R., and Polish names head the entries of places east of the Oder-Neisse line, though from the United States government's point of view the latter were merely placed under Polish administration. On the other hand, Korean places continue to be listed under their Japanese names, as do localities in Formosa, where Chinese

forms are entirely omitted. Although data regarding the political-administrative divisions are generally up-to-date, old provinces (abolished in 1945) are used in Germany, and in Austria the provincial setup established under German occupation (1938-1945) is maintained. Similarly, Fascist names (abolished in 1944-1945) continue to head some Italian entries, such as Littoria (now called Latina) and Mussolinia (since renamed Arborea).

Treatment of the names of the three Baltic republics is particularly poor. In view of their incorporation into the U.S.S.R., an attempt was made to render the Baltic names as they now occur on Russian maps, i.e. in their Russian transliteration. However, this policy was not completely carried out, and the result is an indiscriminate mélange of original Baltic orthography and Russian transliterated forms. In the case of Lithuania, Kaunas continues to be listed as the capital, though it was replaced by Vilnius (Vilna) in 1940.

Similarly, the proper capitals are not given for the Solomon Islands Protectorate, where the government seat shifted from badly battered Tulagi to Honiara after World War II, and for the Gilbert and Ellice Islands Colony, where the headquarters were transferred from Ocean Island to Tarawa.

Throughout the dictionary the latest official censuses have generally been used for population figures, Germany and France being notable exceptions. Although German census reports are available for 1933 and 1939, in addition to the postwar count of 1946, population figures for the majority of German towns have been culled from such an old source as the 1925 census. Similarly, the 1931 census of France has been employed, though figures for 1936 and the postwar 1946 census are available.

Understandably enough, errors of fact in individual articles will occur in a book of such vast scope as a geographical dictionary. The following mistake, however, should be noted for its oddness. On page 574 there appears an entry for Krasny Klyuch, a city of the Bashkir ASSR of the U.S.S.R., with a population of 50,829. However, a check with the 1939 census of the U.S.S.R. shows that this population figure corresponds to the coal-mining center of Krasny Luch in the Ukraine and not to the small Bashkir town, which in reality has a population of only about 4000.

In spite of some of these shortcomings, it should be clear that the Webster Geographical Dictionary will fill a great gap in the field of geographical reference works, at least until the publication of a new standard work similar in scope and elaborateness to the old masters of the turn of the century.—THEODORE SHABAD

NOTICE

Beginning with the January, 1951, issue, the annual subscription rate of the *Geographical Review* will be raised to \$6.00 for both new subscriptions and renewals (agents, \$5.25).

Because of the exceptional demand for the January, 1950, issue, the Society would appreciate receiving copies of that issue from Fellows who do not wish to keep their copies for binding.

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